

## Augmented reality books: concepts, typology, tools

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**Abstract.** The article discussed the usage of augmented reality books in educational process. *The object of research* is augmented reality books. *The subject of the study* is the concepts and classification of augmented reality books; digital story making tools that emphasize child-teacher co-operation; difficulties in augmented reality using. *The methods of research* are: the analysis of publications about the issue; the analysis of digital tools capabilities; systematization and generalization of research information. In the article the facet classification for augmented books is proposed; the main facets are: reality-virtuality continuum, type of augmented materials, device types, type of interaction, spatial space of book, book’s category. Content for a module of a specialty course about augmented reality books for the system of professional training and retraining for educators in postgraduate education is discussed. Some samples of tasks for educators are presented: audio augmented book about world’s books monuments; analysis augmented reality examples in the textbook of the New Ukrainian school (subject name, topic, didactic tasks, quality of implementation, directions of expansion etc.), search and analysis augmented books according to the professional interests of the educators; discussion how augmented reality can help to improve student motivation with accent to attention, relevance, confidence and satisfaction; group work about design and creation a fragment of own textbook with augmented reality.

**Keywords:** augmented reality, augmented books, classification augmented reality books, professional training and retraining.

### 1 Introduction

Augmented reality allows you to combine the real world with virtual objects, and possesses vast and diversified didactic learning opportunities. The use of augmented reality in education has been analyzed by numerous world scientists and Ukrainian researchers in frameworks of the scientific conferences AREdu 2018 [19], AREdu 2019

[18] and AREdu 2020 [9]; discussed in the massive open online courses [12; 15; 16]. A promising area for the use of augmented reality in education is augmented books.

We think another important task is to train teachers to create and use these books during the educational process.

While solving the scientific problem of training educators for using the augmented reality books in education, the following main results were obtained in past author works: the potential of the massive open online courses (MOOCs) about Augmented reality was investigated, the content and program of the specialized course “Augmented Reality as a Storytelling Tool” for the professional development of teachers was described [21], the difficulties of using storytelling in education and ways to overcome them were outlined [22].

## **2 Research objective and methods**

The purpose of this article is to explore the definitions of augmented books, their classification, and tools. Moreover, tools that can be used by children, students, teachers both on their own and together with the purpose to use AR books in a module of a specialized course for the system of professional training and retraining for educators in postgraduate education. This module is proposed as the unit of the author's specialized course “Digital Storytelling in Adult Education” in the Central Institute of Postgraduate Pedagogical Education (CIPPE) of State Institution of Higher Education “University of Educational Management” of NAES of Ukraine. The mission of CIPPE is “in providing social and pedagogical requests and needs in quality new professional level of pedagogical, scientific and pedagogical and leading personnel of education, public officers, able responsibly and efficiently to execute professional activity in conditions of high competition, instability and permanent changes in professional environment” (<http://umo.edu.ua/en/institutes/cippo>). Categories of specialized course's listeners are: methodists of district (city) methodical offices or centres and heads of methodical associations; the teachers of academies and universities.

The methods of research are: the analysis of the publications on the problem of use augmented reality in education; the analysis of concepts regarding AR books; the analysis of software related to augmented reality books; systematization and generalization of research information.

## **3 Results and discussion**

An augmented book represents a “physical or digital copy of a traditional book that contains text and illustrations, and which is connected to additional, non-traditional content through the technology of augmented reality” [13]. When a reader accesses the book page for which additional content is provided, the smartphone or other device reads it and displays this additional content on the screen. Additional content may be an image, a video or an audio (fig. 1) recording, and can also be complex, such as animation, game, or interactive activity.



**Fig. 1.** Augmented book example in Coursera’s course “Getting start with augmented reality”.

Researches place augmented books between virtual and mixed reality books on the corresponding reality–virtuality continuum, presented in the typology: Virtual Book > Virtual Augmented book > Mixed-Reality book > Reality book [13].

Mark Billinghurst proposed the magic book concept [6; 7]. The Magic Book use an ordinary book as the main interface object. Child can turn the book pages, look at the pictures, and read the text without any additional technology. When children look at the pages through a handheld Augmented Reality display, they see three dimensional virtual models appearing out of the pages. Users can switch between the virtual models. When they see a scene they particularly like, they can fly into the page and experience the story as an immersive virtual environment. In the VR mode, users are free to move about the scene at will and interact with the characters in the story. Thus, users can experience the full “Reality-Virtuality continuum”.

Mark Billinghurst notes that the Magic Book interface supports collaboration on three levels [7]:

1. as a Physical Object: multiple users can read together;
2. as an Augmented Reality Object: users with AR displays can see virtual objects appearing on the pages of the book;
3. as an Immersive Virtual Space: users can fly into the virtual space together and see each other represented as virtual avatars in the story space.

By Mark Billinghurst, the interface of Magic book supports collaboration on multiple scales. There are egocentric and exocentric view. Egocentrism is the inability to differentiate between self and other. Readers can fly inside the virtual scenes and see each other as virtual characters (egocentric). Exocentric view also allows a non-immersed reader to see the immersed readers as small virtual characters on the book

pages. This means that a group of collaborators can share both egocentric and exocentric views of the same game or data set, leading to enhanced understanding [10].

Raphael Grasset, Andreas Dünser, Hartmut Seichter and Mark Billinghurst [14] proposed a mixed reality book concept. In this concept the experience with an augmented book can be defined in terms of the spatial properties of books. The four elements, which can be explored by a reader are: inside, outside, outside to inside, inside to outside. So, Inside is augmenting the material in the book pages; Outside is augmenting the space around the pages; Outside to the Inside show interacting from the space around to the content of the book; Inside to the Outside can extracting content from the book.

The author's prototype of mixed reality book consisted of the book, standard desktop computer hardware, a multimodal handheld device, tangible interaction devices (cube, paddles), and an additional green screen. In this prototype with the help of a handheld device the user can naturally get immersed into the mixed-reality book. This device provided visual and aural feedback. As prototype the developers chose the book "The House that Jack Built". This book has contained a lot of images related to the history of New Zealand, the relationship between Maori and European settlers [14].

According to the paper [14], the virtual books are "books completely prepared in an electronic format and involving minimum physicality. Traditional AR books are used by adding virtual elements to physical books. Mixed reality books are composed of virtual insertions at the meaningful level in the manner most similar to physical books".

Tangible AR interfaces [4; 5] combine the enhanced display possibilities of AR with the intuitive manipulation and interaction of physical objects or Tangible User Interfaces. Authors say that experiences with these interfaces show that "the Tangible AR metaphor supports seamless interaction between the real and virtual worlds, and provides a range of natural interactions that are difficult to find in other AR interfaces" [4]. A Tangible AR interface provides true spatial registration and presentation of 3D virtual objects anywhere in the physical environment, while at the same time allowing users to interact with this virtual content using the same techniques as they would with a real physical object.

These are the design principles learned from TUI interfaces:

- The use of physical controllers for manipulating virtual content.
- Support for spatial 3D interaction techniques.
- Support for both time-multiplexed and space-multiplexed interaction.
- Support for multi-handed interaction.
- Support for Matching the physical constraints of the object to the requirements of the interaction task.
- The ability to support parallel activity where multiple objects are being manipulated.
- Collaboration between multiple participants. Authors central hypothesis is that AR interfaces that follow these design principles will naturally support enhanced face-to-face collaboration [4].

Hakan Altinpulluk and Mehmet Kesim [1] analyze augmented reality books of academic nature prepared in the field of education through the literature review technique. They classified 46 augmented books as AR book, augmented desk/paper

augmentation approach, 3D pop-up book, tangible AR approach and MR book. Authors determined 8 studies as MR books and 38 studies as AR books. The researchers say, that augmented desk/paper augmentation approach and game-based children's books called interactive 3D pop-up books go away nowadays. The second tendency they noted, transition from special glasses and head mounted displays to view the books to web cameras integrated to desktops and mobile devices. Another situation noticed when analyzing the studies is that most augmented book studies are not prepared by a single author, and the development of augmented reality books is supported by certain organizations and collectives.

The growing list of books from various authors, platforms, organization, and universities, which is being presented to the world community today, raises questions about the search and selection of the necessary books, their classification.

We have tried to provide a facet classification of digital books, a fragment of which is shown in table 1.

**Table 1.** Fragment of the facet classification of virtual books.

F <sub>1</sub> Virtua- lity conti- nuum	F <sub>2</sub> Type of augmen- ted mate- rial	F <sub>3</sub> Devices	F <sub>4</sub> Interaction	F <sub>5</sub> Book Spatial space	F <sub>6</sub> Cate- gory book	F <sub>7</sub> Type interfa- ce	F <sub>8</sub> Developer
F <sub>11</sub> Virtual Book	F <sub>21</sub> Text	F <sub>31</sub> Only desktop or mobile devices	F <sub>41</sub> Time-multiplexed and space-mul- tiplexed interaction	F <sub>51</sub> Inside	F <sub>61</sub> Story book	F <sub>71</sub> Marker	F <sub>81</sub> Educational insti- tution
F <sub>12</sub> Mixed Book	F <sub>22</sub> Audio	F <sub>32</sub> With spe- cial glas- ses and headsets	F <sub>42</sub> Parallel activity where multiple ob- jects are being ma- nipulated	F <sub>52</sub> Outside	F <sub>62</sub> Text- book	F <sub>72</sub> Marker less	F <sub>82</sub> Binary (Educa- tional institution + organization)
F <sub>13</sub> Aug- mented Book	F <sub>23</sub> Video		F <sub>43</sub> Collaboration be- tween multiple par- ticipants	F <sub>53</sub> Outside to insi- de	F <sub>63</sub> Tutori- al	F <sub>73</sub> Projec- tion	F <sub>83</sub> Consortium of educational insti- tutions
F <sub>14</sub> Reality Book	F <sub>24</sub> 3-D mo- dels		F <sub>44</sub> Mixed	F <sub>54</sub> Inside to out- side	F <sub>64</sub> Map	F <sub>74</sub> Visual Initial Odo- metry	F <sub>84</sub> Company
	F <sub>24</sub> Mixed				F <sub>65</sub> Encyc- lope- dia		F <sub>85</sub> An individual or group

The facet classification system, as we know [11; 26; 29], consists of the parallel division of a plurality of objects into independent subsets – facets. It is also called the “colon”, the Ranganathan classification. The analysis of scientific sources made it

possible to present each such augmented book in the form of a structural formula, which includes 7 facets. Thus, books can be classified according to the level of virtuality; the type of augmented content, the types of devices, interaction, spatial space of book, category etc. For example, some augmented book can be described the following formula:

$K = (F_{12}, F_{21}, F_{31}, F_{41}, F_{53}, F_{64}, F_{71}, F_{81})$ , where  $F_{ij}$  is the  $i$ -th focus of the  $j$ -th facet.

Note that facet classification is easily expanded depending on the book search tasks, for example, within this fragment, we did not knowingly include a subject field; type of education, free or limited access to book materials etc.

The use of AR applications improves motivation of students. One of model of motivation design is proposed by John M. Keller [17]. His model [17] divides learner motivation into four components (attention, relevance, confidence and satisfaction) and called ARCS (fig. 2). This model provided strategies for instructors to incorporate each component into their courses and to choose relevant augmented books.



**Fig. 2.** Model of motivation design by John M. Keller.

Natalia Kucirkova outlines a theoretical rationale of why children's self-made digital books can be important to their learning and wellbeing, and give practical examples of how adults can support children's digital story-making [20]. She introduces the five parameters for children's personalization: authorship of their own stories, autonomy in producing them, authenticity of their contribution, attachment to the final product and aesthetics in its creation. She summarized also the key ways in which the teachers used digital personalized books in their classrooms and proposed the list of question to guide the children's activity as storymakers (table 2).

**Table 2.** Question to guide the children's activity as storymakers [20].

Parameters for children's personalization	Questions
Authorship	To what extent are the stories based on children's own content?
Autonomy	To what extent was the creation of the final product the child's independent work?
Attachment	Who owns the final product?
Authenticity	To what extent do children's stories capture content that is genuine and responsive to the child's own situation?
Aesthetics	To what extent does the final product reflect the child's own taste and preference?

She notes, that depending what digital and human resources are available, children's digital story-making can be of 4 types: guided by the teacher or a teacher's assistant; guided one to one by an older child; collaborative story-making with peers; individual story-making with an app or digital story-making program.

Teachers can combine the various audiences and possibilities for children's self-made stories [20]:

- the whole class with the help of an interactive whiteboard;
- children's parents: as printed booklets or e-books emailed to parents;
- on the screen in a one-to-one with the child's friend or teacher;
- on the screen in a small group with the child's peers;
- electronically with a remote group of children or distant family members;
- electronically or, in the case of a classroom visit, in person with a child books author or illustrator;
- orally at a classroom assembly with other children, teachers, parents and local community members;
- the story is not shared and remains the child's private personal story.

Good foundations for creating stories and teaching this area are presented in [8; 28]. Fig. 3 shows Story Kitchen from Bruce Van Patter [27]. User can pick one hero, one place, and one villain and can read the beginning of history and get to finish it.

**What's cooking?** Wonderful ideas and stories are bubbling deep in your imagination. To get them out, I've made this creative writing help for kids, parents and teachers. Pick one hero, one place, and one villain in the chart below.

Hero	Place	Villain
<input type="radio"/> Superhero	<input type="radio"/> School	<input type="radio"/> Monster
<input type="radio"/> Detective	<input checked="" type="radio"/> Forest	<input type="radio"/> Mystery Guy
<input type="radio"/> Genius Kid	<input type="radio"/> House/Yard	<input type="radio"/> Alien
<input checked="" type="radio"/> Prince/Princess		<input type="radio"/> Wizard

**Before you see the story...** think for a second. *What would you do with the choices you've made? How would you combine them in a story?*

Now click on the button and see how I've put them together. But I'm only going to start the story. **You** get to finish it. And when you do, email me! I'd love to read your ending!

[Make My Story](#)

### *Be Careful What You Ask For*

story & illustration © 2002 Bruce Van Patter

"I am hungry," Prince Zim said.

Nearby, a little old man dropped more sticks into the fire. Sparks flew up into the opening in the trees above them. The old man began to pull on his beard and whine. "I am sorry, your highness. I told you I forgot the food. I'll find some berries."

"No!" shouted Zim, who was known for his boyish temper. "I don't want berries. I want something warm, something that will fill my stomach. I want you to make it with your magic, Yawni."



**Fig. 3.** Pick Prince, Forest and Wizard: story kitchen from Bruce Van Patter [10].

Some other useful applications for Augmented education are: Aumentaty Scope / Aumentary Creator, Wikitude, Quiver Vision / Quiver Education, Star Map / Star Chart AR, Skyview, AR Planet Earth / Geography, 3DBear, CoSpaces Edu, JigSpace, MERGE Cube, Metaverse, Asturica Emerge, Castellones del Ceal AR, Cástulo Virtual, Cisneros Go!, Fuendetodos, La Alhambra - Castillo Rojo, Museo Carlos V and Sorolla Museum AR, Geocaching [24].

Natalia Kucirkova [20] analyzes content of popular software for child story making. Some of such resources are presented in table 3. We agree with the author that the final choice of the tool remains with the teachers, depending on their skills, inclinations, goals, class situation etc.

**Table 3.** Children story making tools.

#	Name	Free or Not	Brief Description	Link
1	StoryJumper	free, but paid for printed version	May be more useful for US-based teachers, since the community resources offer advice specifically linked to the Common Core curriculum.	storyjumper.com
2	Storybird	free	Storybird is a platform for writers, readers, and artists of all ages and is a powerful resource for illustrated stories. The illustrations can be used to inspire children's own picture books or even novels with older writers. Story starts with pictures as prompts for children's own stories.	storybird.com/educators/
3	Story Maker	free	Story Maker available on the British Council's website. Children can choose the type of story, props and characters' names and print the final story out. The resource's focus is on children's learning of basic English vocabulary.	learnenglishkids.britishcouncil.org/games/story-maker-1
4	Little Bird Tales	free and paid option	Little Bird Tales is a subscription site with a choice of a school or home account. Paid membership includes the option for children to use their own photos, voiceovers, text and drawings to make their digital stories.	www.littlebirdtales.com/info/premium/section/teachers
5	My Storybook	free	My Storybook is suitable for the preschoolers and lower-primary-school children. The user interface is very child-friendly, with large icons and pictorial navigation. Final stories can be printed out as a PDF and stored in a library.	www.mystorybook.com
6	Toontastic 3D	free	The Toontastic 3D application is based on story templates and pre-designed props and advertised as a creative storytelling app. It allows children to create 3D cartoons using the app's set of characters, props and backgrounds. The app is managed by Google.	toontastic.withgoogle.com
7	Comic Life	free 30 days version	Comic Life can be used to create comic books using one's own photos. Children's comics can be enhanced with the Comic Life template that can add light effects or specific comic themes. Finished stories can be printed out or saved in the digital library.	comiclif.com
8	MIT App Inventor	free	The MIT App Inventor initiative at the Massachusetts Institute of Technology allows children as evaluate application as well to develop it.	appinventor.mit.edu/explore

Criteria for selecting children's digital books include ordinal criteria and such specific criteria:

- relevant enhancements that support narrative;
- seamless integration of features and enhancements;
- sound effects that don't interfere with voiceover or other features;
- technical polish, stability, ease of use and navigation settings, flexible use;
- no ads, in-app purchases or links that leave the app (unless under sufficient parental gate);
- clearly identified author, illustrator, producer;
- quality games or other activities that do not interrupt narrative or reading comprehension [20].

The author's course module "Augmented reality as a tool for storytelling" contains thematic plan of the module; content of the module by themes; lecture and practical classes plan; independent work of students; practical tasks for self-control; recommended reading [12]. The thematic module unit about augmented books is presented in table 4.

*"Augmented books: concepts and classification" lecture plan.*

Augmented reality in education. Augmented books. Magic book concept. Mixed reality book concept. Typology of augmented reality books. Facet classification. Interface of Augmented books.

*"Software and Internet Services about Augmented Reality books" practical training plan.*

Examples of augmented books. Children's books. Digital stories with augmented reality. Criteria evaluation of digital books. StoryBird. Story Maker. Story Kitchen. App Inventor.

**Table 4.** Thematic module plan.

Thematic module unit	Class format, hours			
	Lessons	Practices	Independent work	Total
Augmented Book concepts and Augmented Book classification. Facet classification.	1		1	2
Digital books tools for pupils. Digital books tools for teachers. Student and teacher co-creation.		1	1	2
Total	1	1	2	4

Sample practice tasks for educators:

1. create a sample audio augmented book about book monuments of the world (according to the guidelines of course "Getting started with Augmented Reality")

Augmented reality is manifested in the form of the author's accompanying text about the monument of the book, for example for fig. 4. *"In Berlin at Bebelplatz on Unter den Linden Boulevard, in front of the Humboldt University building, a twenty-meter monument weighing 35 tonnes was opened, consisting of 17 books by German authors. The sculpture is set in memory of Johann Gutenberg, the inventor of modern printing".*



**Fig. 4.** The sculpture is set in memory of Johann Gutenberg, the inventor of modern printing: 17 books by German authors (<https://lesoteka.livejournal.com/78147.html>).

2. analyze augmented reality examples in the textbook (fig. 5) of the New Ukrainian school (subject name, topic, didactic tasks, quality of implementation, directions of development etc.);



**Fig. 5.** Augmented reality example in the textbook of New Ukrainian school (<https://www.youtube.com/watch?v=rWLWkKkV1SQ>).

3. find and analyze some augmented books according to the professional interests of the student;
4. discuss how augmented reality can help to improve student motivation: attention, relevance, confidence and satisfaction;
5. group work: design and create a fragment of their own textbook with augmented reality.

We also think that the use of AR technology will facilitate the co-creation of students and teachers. We understand co-creation [23; 24; 25] as a joint creative activity of a

teacher and a student, aimed at developing the educational environment and ourselves in this environment.

The scientist's research of difficulty to use AR is presented in [2]. Julio Barroso Osuna, Juan Jesús Gutiérrez-Castillo, M<sup>a</sup> del Carmen Llorente-Cejudo and Rubicelia Valencia Ortiz present, that experts pointed out what might present the most difficulty:

- lack of teacher training;
- lack of educational experience;
- lack of conceptual foundation;
- lack of educational research;
- institutional difficulty / lack of institutional support.

In our research [22] we study the problem of the use of storytelling technology in educational process. According to the survey of teaching staff and methodologists of different professions while they were taking retraining courses, only a quarter of respondents use or have used this method, and about 72% of respondents are ready to consider it. A 3-factor model on possible barriers that impede the use of digital storytelling in education was developed on the basis of the empirical data with the help of a factor analysis tool. The first factor was related to the lack of necessary resources, the second one – to resistance to change, the third one – to the lack of time and lack of technical and methodological support from the educational institution. As we see, the last factor is the same as in research [2].

What are possible ways to overcome these barriers? According to some scholars [30], an inappropriate level of professional development can also be a barrier to the use of information technology in general and digital staging in particular. Peter G. Taylor proposes a strategy for engaging a critical mass of staff in a technology-augmented educational practice and identifies 5 required steps: orientation, acceptance, evaluation, innovation, and institutionalization for professional development programs [30, pp. 275–276]. Let's look at these steps in more detail, with a focus on using AR books.

At the orientation stage, teachers are considering approaches to integrating augmented reality technologies into teaching and learning that meet current educational expectations, technology availability, and the requirements of the educational institution's curriculum and the subject matter they teach. During the adoption phase, educators adapt current intentions and practices to teaching and learning using augmented technology in a high-tech learning environment. They then evaluate these practices (evaluation phase). In the next phase, innovators and educators re-develop their practice based on their own experience of digital story technology in a high-tech environment of the educational institution and study the reactions of the educational recipients to them. At the institutionalization stage, educators and managers develop strategies to ensure that new teaching and learning methods are maintained in the medium and long term and thus become “traditional”.

The first three phases (orientation, acceptance, assessment) – we relate to the first period of teachers training and retraining, which is full-time; the fourth phase (innovation) – with the inter-course period of teacher training and retraining; the fifth phase (institutionalization) – partly with the third period of teacher training, which is also full-time and with course work's presentation. We agree with Peter G. Taylor that

each of these stages requires different approaches to professional development and should include time for reflection, specific training, discussion, consideration of alternative practices, and transformation of accepted practices. We consider it important - the organization of pedagogical support for teachers in these areas.

It would be interesting to apply Zane L. Berge, Lin Y. Muilenburg and James Van Haneghan [3] methodology (they studied barriers in distance learning) to the study of difficulties in using AR in education.

Note that recently there have been special programs that train specialists in augmented and virtual reality.

So, for example, Singapore University of Social Sciences offers a three-year program Virtual Reality and Augmented Reality (MTD369) [31]. The content of the first two years of preparation is shown in fig. 6. This list of courses gives an idea of the diverse training of specialists. We can take note of such courses as creativity and imagination, storytelling, narratives and experience for training teachers in this direction.

First year	Second year
<p><b>Core</b></p> <p><a href="#">Introduction to Computer Programming for Games (GAV4005-B)</a></p> <p><a href="#">Introduction to 3D Computer Animation (GAV4007-B)</a></p> <p><a href="#">Creativity and Imagination (FAM4001-B)</a></p> <p><a href="#">3D Character Modelling and Animation (GAV4003-B)</a></p> <p><a href="#">Introduction to Virtual Reality (GAV4013-B)</a></p> <p><a href="#">Creative Industries - Foundations (GAV4006-B)</a></p>	<p><b>Core</b></p> <p>Augmented Reality Design: Principles and Practice (GAV5023-B)</p> <p>Soundscapes (FAM5001-B)</p> <p>3D and VR Workflows and Theory (GAV5022-B)</p> <p>Look Development, Lighting and Advanced Rendering (GAV5016-B)</p> <p>Advanced Game Technology and Development (GAV5025-B)</p> <p><b>Option</b></p> <p>Digital Compositing and Post Production (GAV5018-B)</p> <p>Motion Capture and Digital Scanning (GAV5017-B)</p> <p>Storytelling, Narrative and Experience</p>

Fig. 6. VR Program and AR Program in Singapore University of Social Sciences [31].

## 4 Conclusions

Thus, the augmented reality can provide modern education with new didactic measurements and tools at the teacher and student level, contribute to a better understanding of complex topics, visualize hidden processes, and so make it acceptable for adults and people with disabilities. An augmented textbook is a new educational tool, it can contain fragments of video lectures, electronic pads such as Padlet, augmented quizzes, 3D models, animated tours in the history of the problem being studied, in-depth exercises, didactics games etc.

The facet classification of augmented reality books is offered on the basis of the

analysis of the scientific sources about these books. The main facets are: reality-virtuality continuum, type of augmented material, devices, type of interaction, spatial space of book, book's category. The author's specialized course "Digital Storytelling in Adult Education" for the system of professional training and retraining of educators is updated with augmented book creation module.

The further development of the study is seen in the didactics analysis of the new apps for creating augmented textbook, clarification of the facet classification proposed and detail learning of barriers in the use of augmented reality in education, in particular, by methodology of Zane L. Berge, Lin Y. Muilenburg and James Van Haneghan [3].

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