

Application of augmented reality in the linguistic and literary education of primary school students

Liudmyla L. Nezhyva¹, Svitlana P. Palamar¹, Olha V. Kotenko¹,
Liudmyla A. Nazarenko² and Maryna S. Naumenko¹

¹Borys Grinchenko Kyiv Metropolitan University, 18/2 Bulvarno-Kudriavska Str., Kyiv, 04053, Ukraine

²Mykolaiv Regional Institute of Postgraduate Pedagogical Education, 4-A Admiralska Str., Mykolaiv, 54000, Ukraine

Abstract. This paper explores the application of augmented reality (AR) technology in primary school students' linguistic and literary education. A review of current research on AR in education is presented, including studies on AR books for literacy instruction and reading motivation. The benefits of AR for enhancing students' reading comprehension, critical thinking, and imagination are discussed. AR features are analysed in new "Living Alphabet" books used in Ukrainian schools. The development of a mobile AR application for interactive reading lessons on fairy tales is detailed; this app allows students to actively engage with literary characters and settings in an immersive 3D environment. Pedagogical models employing AR applications, games, and theatre activities are proposed to improve literary reading instruction and foster key competencies aligned with the Ukrainian New School curriculum. The paper concludes that when thoughtfully implemented, AR technology can enrich primary students' linguistic and literary learning. Further research is recommended to prepare teachers to integrate AR into language arts instruction.

Keywords: augmented reality, primary education, linguistic education, literary education, reading lessons, fairy tales

1. Introduction

1.1. The problem statement

New virtual (VR) and augmented reality (AR) technologies have quickly gained popularity worldwide. Currently, visualised content on various topics is used with the help of modern electronic devices in diverse fields, including science, manufacturing, technology, marketing, design, entertainment, medicine, and education. VR and AR applications are already actively employed as teaching aids in schools across America and Europe. Augmented reality technology has become especially widespread due to its easy and convenient use on smartphones and

✉ l.nezhyva@kubg.edu.ua (L. L. Nezhyva); s.palamar@kubg.edu.ua (S. P. Palamar); o.kotenko@kubg.edu.ua (O. V. Kotenko); liudmyla.nazarenko@moippo.mk.ua (L. A. Nazarenko); m.naumenko@kubg.edu.ua (M. S. Naumenko)

🌐 <https://eportfolio.kubg.edu.ua/teacher/2445> (L. L. Nezhyva); <https://eportfolio.kubg.edu.ua/teacher/1109> (S. P. Palamar); <https://eportfolio.kubg.edu.ua/teacher/492> (O. V. Kotenko);

<https://scholar.google.com/citations?user=5JZFydMAAAAJ> (L. A. Nazarenko);

<https://eportfolio.kubg.edu.ua/teacher/2362> (M. S. Naumenko)

🆔 0000-0001-9520-0694 (L. L. Nezhyva); 0000-0001-6123-241X (S. P. Palamar); 0000-0001-8967-8130 (O. V. Kotenko); 0000-0001-6560-5252 (L. A. Nazarenko); 0000-0001-8927-4427 (M. S. Naumenko)



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tablets. With AR apps on handheld devices, students can individually or collaboratively explore topics like the solar system, water molecules, plants and animals, travel, literacy, and art.

By examining global best practices of implementing augmented reality in education, researchers and teachers in Ukraine are developing AR apps and theorising methodological models for application in the classroom. Modern advancements in information and communication technologies allow for further modernisation of the primary school curriculum to meet contemporary needs and reformed educational goals. The field of literary education has also evolved, with new “Living Alphabet” books appearing in Ukrainian first-grade classrooms. These interactive books use the FastAR Kids app on smartphones and tablets (iOS, Android) to activate 3D augmented reality content based on poem storylines and animated characters. Some teachers use the alternative “Kobzar’s Alphabet”, which brings Taras Shevchenko’s works to life for each letter. However, systematic methodological frameworks have not yet been established for using such books, so integrating AR into literacy lessons is currently inconsistent rather than pervasive.

The imaginative nature of literature, with its innate integration into multimedia, necessitates partially revitalising the artistic realm with AR technology during the reading process. In developing primary students’ lifelong learning skills, imparting critical thinking, aesthetic sense, and emotional intelligence is vital. Dialogic interaction with literary works will be significantly enhanced by leveraging AR to stimulate creative imagination through emotional resonance.

Among the array of augmented reality applications in primary education, AR apps like “Animals 4D” are already used in the integrated “I Explore the World” course, bringing the animal kingdom out of the pages into tangible reality. This research details AR implementation in the linguistic and literary sphere. Several children’s books with companion AR apps suitable for reading lessons are suggested. A study confirmed the effectiveness of AR (WowBox) when examining Lewis Carroll’s “Alice in Wonderland” and a Ukrainian short story. However, systematic methodology has not yet been established for applying AR in literacy and reading lessons in grades 1-4.

1.2. Literature review

We analysed the current state of research on the use of AR applications in education [4]; studied the experience of combination of AR with learning based on games in primary school [14, 21], the impact of integrating game approaches with augmented reality on learning [26, 27], improvement of learning efficiency and students’ motivation through the use of AR applications on smartphones [5].

Possibilities of application of AR technologies in different fields of education were considered by Pochtoviuk, Vakaliuk and Pikilnyak [23]. The authors noted the significant impact of the presentation of educational material by augmented reality on the development of facial expressions and attention, stimulating thinking and increasing the level of understanding of information. Among the benefits, scientists point to realism, clarity, completeness, information and interactivity. The didactic potential of a virtual information learning environment is determined by Bondarenko, Pakhomova and Lewoniewski [1]. Scientists emphasise such features of VR and AR as immersion, dynamism, sense of presence, continuity, causality, intensification of the process of cognition, and saving time for processing the material. While acknowledging the

effectiveness of learning with the help of VR and AR, the authors also point out the disadvantages, including low computerisation, low number and low quality of software products [1], difficulties in applying these technologies, such as small experience in using this technology, lack of methodological literature, lack of developed methods of AR implementation [9]. Lacunae of augmented reality educational products are filled by practitioners who create mobile applications to visualise educational material, including the chemical structure of water and display video data from laboratory experiments to study subjects of the natural cycle in primary school. Innovative is the experience of developing a mobile application, LiCo.SolarSystem is designed to visualise the solar system using AR technology and study the alphabet using astronomical definitions [15]. According to the authors of the LiCo.STEM and LiCo.SolarSystem applications (can be downloaded from a publicly available Google Play Market resource), its contributes to the development of cognitive motivation of primary school students and educational energy, their imagination, creative initiative and research activity [16].

Walsh et al. [28] offer the development and implementation of educational tools using virtual and augmented reality for language learning in primary school. Sekerin et al. [25] outlined the prospects for the implementation of the latest educational technologies that allow to increase the effectiveness of teaching. Thus, they found that 20% of students are ready to receive educational information from conventional sources, and 80% of students need an interactive perception of information based on augmented reality. According to Sekerin et al. [25], carrying out lessons with the help of virtual reality tools contributes to students' full involvement in the educational process and, accordingly, success in acquiring knowledge. For primary school students in Ukraine, a textbook and universal didactic material from AR for the integrated course "I explore the world", aimed at developing research skills [8], has already been created.

Most of the publications on the identified problem (Burov and Pinchuk [2, 3], Gayevska and Kravtsov [7], Kanivets, Kanivets and Gorda [10], Klochko and Fedorets [12], Mintii [17], Nechypurenko, Semerikov and Pokhliestova [18], Oleksiuk and Oleksiuk [20], Piatykop et al. [22]) testify to the possibility of using VR and AR technologies in the educational field for visual modelling of educational material; supplementing its visualisation; developing students' spatial ideas; research and experimentation skills; three-dimensional design, which saves time for learning information, accelerates learning and makes the process fun and engaging.

1.3. The aim of the research

Thus, augmented reality is increasingly used in primary education, special educational applications have been developed in natural sciences, and AR textbooks have been created for primary school students for "I Explore the World".

Among the many tools of augmented reality technologies in the educational process of primary school, one uses AR applications such as "Animals 4D" in the integrated course "I Explore the World". Encyclopedias of the Ukrainian manufacturer with augmented reality iEXPLORE, which transfer the animal world from the book's pages to reality, are designed to instil curiosity in children to acquaint them with the magical world of animals, insects, beetles and dinosaurs.

The authors of this article outlined the prospects for the application of augmented reality in the linguistic and literary field of primary school. Several editions of works of art by Ukrainian

and foreign writers with AR applications, which should be used in reading lessons, are named. We conducted a study of the effectiveness of using AR applications in reading lessons in primary school with the definition of their benefits for enhancing students' reading activities [19]. However, there is a need to systematically develop methods for applying augmented reality in literacy and reading lessons in 1st-4th grades and test their effectiveness for developing primary school students' subject and key competencies.

The recommendations of the European Parliament and the Council on Key Competences for Lifelong Learning refer to the formation of key competencies that help individuals to socialise successfully. For the main competencies, such reference frameworks as critical thinking, creativity, initiative, and the ability to constructively manage emotions are named [6]. Such personality qualities are formed during reading activities, which will be enhanced by augmented reality.

The study aims to develop a mobile AR application on the Android platform designed to organise play activities of primary school students during reading lessons while studying fairy tales and modelling methods of application of augmented reality technologies in the linguistic and literary field of primary education, which teachers and students can use for practical training on methods of literary reading in primary school.

2. Discussion and results

AR technologies provide a three-dimensional field of human perception of virtual information, which can be perceived as elements of real life. With the help of augmented reality, images, videos, text and graphics are projected beyond the screens of smartphones or tablets with the AR function. In this way, virtual objects are combined with the natural environment. With the help of a 360° picture, the boundaries of the creative imagination of a junior school child can be maximally expanded. Quality augmented and virtual reality content blurs the line between the artificial and real worlds. With the help of gadgets, as if through a window, the student observes a fantastic image of the world (scientific, technical, artistic, etc.), explores, cognises its laws, and learns to change it for the better. Therefore, using these technologies causes maximum expression in students and, most importantly, allows them to interact actively with various objects of study in three-dimensional space. Thus, augmented reality technologies allow students to perceive artistic images in an entertaining form of the game to get closer to understanding the artistic world of a literary work. In this study, we will take into account the most essential advantages of immersive technologies, namely [27]:

- clarity, which allows one to examine in detail any process or object easily;
- concentration, which allows one not to be distracted by external stimuli and to focus on the lesson material;
- maximum involvement of students in the learning process;
- the effectiveness of awareness and memorisation of important educational information, etc.

Primary school students can begin their acquaintance with augmented reality in the 1st-grade. Today, many Ukrainian schools are provided with an interactive edition of "Living Alphabet"

with the application FastAR Kids for smartphones and tablets (iOS, Android). The alphabet pages can be revived from the first literacy lessons (figure 1). While working with this alphabet, we offer first-graders not only to listen to poems, fairy tales, and helpful information but also advise teachers to set the following tasks for students: observe the heroes of stories, learn to interact with them, explore their appearance and emotional state, pay attention to the environment, orally describe what was seen and heard, etc.



Figure 1: Demonstration of augmented reality according to the publication “Living Alphabet”.

A more complex but not less interesting format of the interactive edition is the “Kobzar’s Alphabet” (Kyiv, 2019) with the application FastAR Kids (figure 2). In special literacy lessons, this alphabet can be used as an alternative. Students are invited to get acquainted with the works of the classic of Ukrainian literature, Taras Shevchenko, in an exciting and relaxed way by “reviving” high-quality illustrations of these works.

It is important that such an alphabet effectively helps first-graders with different levels of readiness to learn to read and understand words and sentences, provides an opportunity not only to update knowledge about the letters of the Ukrainian alphabet and corresponding sounds but also to hear the clear reading of Kobzar’s poetic lines accompanied by augmented reality. The teacher is invited to draw students’ attention to the melodiousness of the native language and to the beauty of Ukrainian landscapes, activated by the AR application, to emphasise the spiritual values of Kobzar’s poetry. Thus, with the help of augmented reality, the tasks of the main semantic lines of study according to the current school program of the 1st-grade of the New Ukrainian School are realised, namely:

- “Interact orally”. Students perform actions to activate augmented reality following the listened instructions; answer questions on the content of what is heard and seen (who? what? where? when? how?); tell what is said in the text, activated by augmented reality;

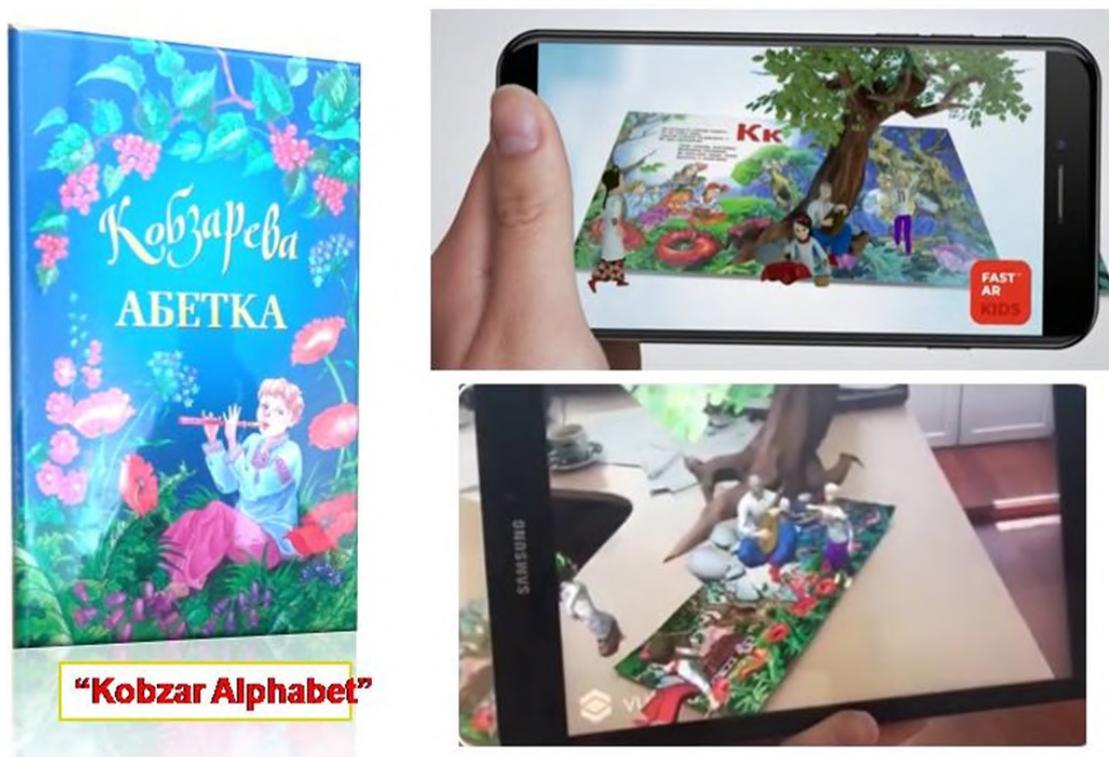


Figure 2: Demonstration of augmented reality according to the publication “Kobzar’s Alphabet”.

share their feelings and emotions from what they have heard and seen; tell what has interested them; reproduce emotionally in roles (with students or teachers) the dialogue of the characters; learn to use non-verbal means (gestures, facial expressions, etc.) according to the communication situation; repeat samples of coherent utterance (2–3 sentences) while preserving its content and intonation features; retell a short listened text based on augmented reality; independently build a short coherent statement based on the listened text or augmented reality.

- “*Exploring the media*”. Younger students, working with media products, learn to perceive the content and form of simple media products, among which there are not only the usual pictures, comics, and cartoons, but also augmented reality, participate in its discussion, share their impressions of listened to / viewed media products.
- “*Exploring linguistic phenomena*”. Students explore speech sounds and their correct pronunciation by activating augmented reality applications, learning the correspondence of sounds and letters, and observing the lexical meaning of words.

Thus, there is another effective means of teaching literacy to primary school children – augmented reality, which contributes not only to the successful study of the Ukrainian alphabet but also a casual acquaintance with classical examples of literature and spiritual values reflected in it, ensures the development of speech, imagination, critical thinking, emotional intelligence of primary school students.

In primary school, it is appropriate to conduct interactive reading lessons using art books for children with augmented reality, notably a series of books, "Read and Play", by the Ukrainian publishing house Art Nation Publishing. One has confirmed the effectiveness of the use of augmented reality (WowBox AR) in the process of studying Lewis Carroll's fairy tales "Alice in Wonderland" and "Alice Through the Looking-Glass", as well as the application of The Pumpkin's Year during the creative reading of a short story for children called "Pumpkin Year" by Ukrainian writer K. Babkina. In the extracurricular reading lesson, the model of studying E. Hoffman's work "The Nutcracker and the Mouse King" was successfully applied with the activation of the WowBox AR application. The use of interactive pages of this edition and additional bracelets contributed to the activation of readers in the virtual art world and, thus, the implementation of the tasks of the content lines of the program of the New Ukrainian School. In particular, within the line "Theatricalize", students had the opportunity, wearing bracelets and playing the roles of the heroes of the fairy tale, to observe unfamiliar (spectator) and to express their own (actor) expression. Thus, students were curiously involved in stage art, gaining performance experience and trying to improvise. Observation of artistic expression through augmented reality, work with interactive colouring pages and stickers, and expression of appropriate emotions through acting ensures the development of the child's emotional intelligence, creative thinking, initiative, self-awareness, self-control, ability to overcome barriers associated with uncertainty and risks, effectively cooperate with and understand one another.

It is becoming increasingly difficult to draw a young reader's attention to a book in the modern conditions of the informatisation of society. Children get used to gadgets from an early school age, gradually becoming one of the leading ways of learning about the world. This problem has become even more acute in a pandemic when the distance learning format has become more active in the education system [13]. At the same time, we should remember the importance of the art book, reflected in the fiction aesthetic, spiritual, and moral values for the formation of the personal image of the world of the student. The art of the word enriches with new knowledge, has powerful educational potential, develops speech, figurative thinking, creative imagination and emotional intelligence, promotes awareness of national identity and socialisation of the individual, causes unforgettable impressions, and gives aesthetic pleasure. Therefore, there is a need to open the value of fiction for younger students, to form the interests of readers, and to demonstrate the uniqueness of literary reading.

This study is devoted to creating an augmented reality application to the topic "Ukrainian folk tales". Since the leading activity in primary school is gaming, the AR application for a fairy tale was created as a game-trip to the same story. The development of the application provides for the following tasks:

- *Analysis of the work.* Describe the place and time of events, characters (motives of behaviour, causes of feelings and emotions, relationships between characters);
- *Interpretation of the work.* Conduct dramatisation, creative translation, and continuation of the text; evaluate the experiences and emotions of the characters;
- *The emotional impact of works on the reader.* Describe the mood, feelings of the characters of the work and one's own emotions caused by reading a fairy tale; compare these emotions with the feelings caused by events in one's own life; characterise the favourite character, substantiate the sympathy, the reasons of empathy to the character.

Thus, with the help of the Unity program [11, 24] and the Vuforia plugin, augmented reality was created to accompany the creative reading of the fairy tale “Kotygoroshko” (figure 3).



Figure 3: The process of the development of the application to “Kotygoroshko”.

The basis of the game-trip is a fairy tale map with stations and special interactive tags – circles of different colours (figure 4).



Figure 4: Interactive map of the game-trip for the activation of the AR applications under the fairy tale “Kotygoroshko”.

In order to activate the augmented reality on the map and complete the lesson tasks, students form groups. For convenience, students in each group receive stickers of the same colour (red, blue, green, yellow). To animate the interactive parts of the travel map (coloured circles), one needs to download a specially designed AR application (figures 5, 6) on the smartphone or tablet and point the gadget to the colour wheel of the command of the respective station. A specially designed program attaches a virtual AR object to the label and activates the image of the hero, the episode of the fairy tale, and the text of the question on the screen. Each group of students “animates” it with the help of AR applications on each of the four stations of the circle of the corresponding colour.



Figure 5: Activation of the interactive part of the travel map “Look and tell”. Fragment “Battle”.



Figure 6: Activation of the interactive part of the travel map “Look and tell”. Fragment “Appearance of Kotygoroshko”.

The first stop of the game trip is dedicated to retelling a fairy tale. According to the stop’s name, performing the actions “Look and tell” is suggested. Each group of students “animates” the circle of the corresponding colour, and a fragment that needs to be transferred appears on the smartphone. The group of students is offered the task of making a plan for retelling a fragment of a fairy tale visualised with the help of an AR application and determining the speakers according to the plan. The teams were offered the following fragments: “Red” – a fragment of “Brothers and sister have disappeared”; “Yellow” – a fragment of the “Appearance of Kotygoroshko”; “Green” – a fragment of “Battle”; “Blue” – a fragment of “Betrayal of brothers”.

The task of the second stop, “Who is who?” of the fairy-tale travel game, is the characterisation.

Each team “revives” its hero from the fairy tale “Kotygoroshko”, watches him, remembers the text of the fairy tale and characterises it by features: the appearance of the hero, emotions experienced by a fairy-tale hero, positive and negative features, mistakes or achievements of the hero; one’s attitude to the hero (figure 6).

The next stop of the fabulous game-trip is “Think”. At this stop, students visualise the questions based on the fragments of the fairy tale told by the students. While activating the red label, the students asked What happened in Kotygoroshko? Explain why, after Olenka’s disappearance, the brothers also disappeared. Name the reasons for the return of the brothers. Why did the brothers lose the battle? What advice would you give them to win? Evaluate the actions of the brothers. While activating the yellow label, students pondered the following questions: When did Kotygoroshko appear in the family? Explain why people were afraid of his power. In what way do you think one can use Kotygoroshko’s force? Complete the preparation for the battle of Kotygoroshka and the brothers. Explain why Kotygoroshko was so confident in his strength. What would you recommend to Kotygoroshka when he was preparing for the battle? Consider what influences the victory? While activating the green label, the students analysed the fairy tale in the following directions: Who did Kotygoroshko meet when he came to the snake? Explain Olenka’s behaviour during the meeting with Kotygoroshko. Consider whether Kotygoroshko could negotiate with the snake and not fight. Suggest possible solutions in the fight between Kotygoroshko and the snake. How do you feel about Kotygoroshko’s act? Name the advantages of Kotygoroshko in contrast to his brothers. While activating the blue label, the students answered the following questions: Was Kotygoroshko able to free his brothers and sister? Why did Kotygoroshko not admit to the boys that he was a brother? Why did the brothers decide to get rid of Kotygoroshko and free him from their trap? Advise Kotygoroshko on how to act in the situation that developed at the end of the fairy tale. What would you tell your brothers to do in the current situation? Try to model the other possible end of the fairy tale.

3. Conclusions and prospects for further research

The presented research highlights the potential for using AR applications in the literary education of primary school students. According to the authors, augmented reality technology meets contemporary social and educational needs, aids in achieving the goals of the New Ukrainian School’s literary curriculum, and fully immerses younger students in the artistic realm while stimulating their imagination.

Given the nature of literature and key principles of teaching literary reading at the primary level, this paper delineates several areas for AR integration in early literary education:

- visualising, examining, and exploring artistic images and expressions;
- visualising, examining, and exploring the artistic world constructed in a literary work;
- facilitating reader interaction with literary characters;
- enabling game-based learning through AR (studying works via AR games);
- organising theatrical performances using interactive AR bracelets and stickers.

A mobile AR application for Android was developed as an interactive storytelling game to facilitate engaging play-based fairy tale reading lessons. The app aligns with the current literary reading program objectives of analysing/interpreting works and eliciting emotional reader responses. AR allows teachers to deepen resonance with texts, motivate interest in oral folklore, spur creative thinking, and build students' emotional intelligence, empathy, collaboration skills, and self-awareness. AR also qualitatively visualises literary worlds, boosts memorisation, develops critical and metaphorical thinking through games, and encourages student creativity and initiative.

Overall, thoughtfully implemented AR can enrich primary students' linguistic and literary learning. Further research should examine preparing teachers to integrate AR into language arts instruction. Additional exploring areas include studying student and teacher readiness to use AR apps, investigating impacts on literacy development and reading skills, designing AR-infused language arts curriculum units, and creating more interactive AR books. As AR technologies and applications continue advancing, they have immense potential to engage young readers in new immersive environments that captivate their imagination and promote essential competencies.

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