THE USE AUGMENTED REALITY TOOLS BY TEACHER FOR INQUIRY-BASED APPROACH OF STEAM-EDUCATION IN GENERAL SCHOOL

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Abstract. The aim of the research is to implement the ways of using augmented reality tools by the teacher for inquiry-based approach of STEAM-education. The objective of the study is to use augmented reality tools by teachers for inquiry-based approach of STEAM-education in their professional activity. The object is an inquiry-based approach in general school. The subject is the use of augmented reality tools by teacher with the inquiry-based approach of STEAM-education in general school. The study is focused on teachers from secondary schools (Semipolkivska Secondary School of the 1st-3rd Grade (Ukraine), Specialized school №181 named after I. Kudri with in-depth study of foreign languages (Kyiv, Ukraine)) to determine their attitude to using augmented reality in STEAM-education with inquiry-based approach. The study involving 27 teachers of a comprehensive school was conducted from September to December 2021. According to the results of the study, it has been concluded that among the ways of using augmented reality tools by teachers for the inquiry-based approach of STEAM-education, are the following: submission of new material and brainstorming; representation of objects and processes that are difficult to show in real life, for testing. Prospects for further research are to create a special course for teachers which will teach them to use augmented reality tools in professional activities to support and develop STEAM-education.

Keywords: augmented reality, augmented reality tools, inquiry-based approach, STEM, STEAM-education, general school.

ВИКОРИСТАННЯ ІНСТРУМЕНТІВ ДОПОВНЕНОЇ РЕАЛЬНОСТІ ВЧИТЕЛЕМ У ПРОФЕСІЙНІЙ ДІЯЛЬНОСТІ ДЛЯ РЕАЛІЗАЦІЇ ПІДХОДУ НА ОСНОВІ ЗАПИТІВ У STEAM-ОСВІТІ

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Анотація. Метою дослідження є реалізація способів використання інструментів доповненої реальності вчителями у професійній діяльності для підходу на основі запитів у STEAM-освіті. Предметом дослідження є підхід на основі запитів для реалізації STEAM-освіти вчителями у професійній діяльності. Дослідження орієнтоване на вчителів загальноосвітніх навчальних закладів (Семиполківська ЗОШ I-III ступенів (Україна), Спеціалізована школа №181 ім. I. Кудрі з поглибленим вивченням іноземних мов (Київ, Україна)) з метою визначення їхнього ставлення щодо використання доповненої реальності в STEAM-освіті з підходом на основі запитів. Дослідження за участю 27 вчителів загальноосвітньої школи проводилося з вересня по грудень 2021 року. За результатами дослідження зроблено висновок, що серед способів використання вчителями інструментів доповненої реальності для реалізації підходу на основі запитів у STEAM-освіті слід виділити такі: подача нового матеріалу та мозковий штурм; представлення об'єктів і процесів, які важко показати в реальному житті, для тестування. Перспективами подальших досліджень є створення спеціального курсу для вчителів, який дасть можливість навчити їх використовувати інструменти доповненої реальності у професійній діяльності для підтримки та розвитку STEAM-освіти.

Ключові слова: доповнена реальність, інструменти доповненої реальності, підхід на основі запитів, STEM, STEAM-освіта.

Introduction. Numerous studies have highlighted the current need for professionals in all fields with twentieth-century skills such as critical thinking, inquiry, creativity, problem-solving, collaboration, digital literacy [1; 2].

In order STEAM skills, that is such as encompasses science, technology, engineering, art and mathematics, are one of these key competencies needed in a future knowledge-based society for employment, personal fulfillment and development.

However, there is a gap between how STEAM-related disciplines are taught in secondary schools and the 21st century skills needed by students to real-life situations while studying and pursuing STEAM-related careers. This means that teachers still teach the way they were taught by students. Therefore, teaching approaches need to be renewed through dynamic educational processes, which will allow adapting this approaches and resources to develop these critical skills.

The important ways for STEAM-education integrated in general school are problem-based or discovery learning, where learners learn by addressing and posing questions, analysing evidence, connecting such evidence to pre-existing knowledge, drawing conclusions and reflecting upon their findings, using the information and communication technologies (ICT), in particular the augmented reality tools, that can provide an approximation of reality for students to better understand subjects in the fields of STEAM.

The purpose of the work. The study is the implementation of the ways of using the augmented reality tools for inquiry-based approach of STEAM-education in general school.

Formulation of the problem. Inquiry-based approach (IBA) adopts John Dewey's principle that education begins with curiosity (Savery, 2006 [3]), and makes students go through all the steps of scientific research: ask a question, develop a hypothesis, plan how to test this hypothesis, collect data, analyse the results and share it with peers (Pedaste et al. 2015 [4]). IBA is ideal for science education, because it makes teaching more hands-on, and is perfect to learn how scientific research works. Students learn how to formulate questions answerable through experimentation. The teacher has both a facilitator role and an instructor role, making it an in-between method compared to full facilitation in problem-based, and instruction in project-based learning. However, the approach can be gradually made student-directed; students can start an IBA project with a question provided by the teacher, and then can come up with their own questions to transfer what they learned for deeper learning.

The learning project is especially interesting for the implementation of STEAM-education, even if teachers will use to support and organize innovative technologies and tools such as AR.

Augmented reality tools are especially important in the implementation of the inquiry-based approach by teachers to support and develop STEAM education. AR application in STEAM education brings lessons and textbooks to life by combining video, photos, and audio in an interactive platform (Nawarat Wittayakhom & Pallop Piriyasurawong, 2020) [5]. This provides students with an engaging way to learn that can make complex subjects and topics easier to grasp and understand makes teaching easier where teachers no longer need to explain complex concepts

Solving the problem. To implement the IBA of STEAM-education in general school, we asked teachers to plan and organize a learning project for their students on the use of AR.

The following tools were proposed:

- to study specific topics (for example, M&G AR Cards: Cellular Biology, The Brain AR App, AR Eye, Skyscrapers AR, GeoGebra 3D with AR);

- to create their personal examples (for example, metaverse, blippar).

One of the interesting projects created by teachers should be noted project «Mask and the environment». The main idea is to make students conscious of the damage caused to the environment by the large amount of masks discarded by people during Covid-19 pandemia and to make them research the principle behind biodegradable objects. Students are expected to demonstrate understanding of how the selected topic- apparently a very simple one- can open a wide scenario of learning opportunities. They need to understand why masks are needed in real life; how these tools are related to human health and ecology. They must be creative and logical in creating the design of masks, using knowledge of biology, maths, technology, history, art,

English, etc. Through a multidisciplinary approach they will learn to consider the same matter from different perspectives, which is an essential requisite in promoting the development of a scientific mindset. Emphasis made on the STEM topics and competences, the interdisciplinary instruction and the contextualization of STEM and non-STEM teaching, connecting the classroom to a real world experience such as the use and disposal of face masks.

In the process of conducting research by students, teachers asked them to perform the following tasks using AR: Make an example of augmented reality «face and mask» using any of the platforms such as: ARCore Augmented Images (https://codelabs.developers.google.com/codelabs/augimg-intro?utm_source=google-io&utm_medium=organic&utm_campaign=io21-learninglab#0); Blippar (https://blipps.blippar.com/; instructions in appendix 2); Create a Mind map «types of face masks»; «materials for face masks»; «ecology and use of face masks» (https://miro.com); create a virtual museum using platforms to create AR.

To obtain the objectives, our research is focused on teachers from Secondary schools (Semipolkivsky Secondary School of the 1st-3rd Grade (Ukraine), Specialized school №181 named after I. Kudri with in-depth study of foreign languages (Kyiv, Ukraine)) to determine their attitude to using augmented reality in STEAM education with inquiry-based approach. The study involving 27 teachers at the general school was conducted from September to December 2021.

The questionnaire content is aimed to obtain answers to the following questions:

The questionnaire content is aimed to obtain answers to the following questions: Do teachers consider it required to use AR tools in teaching at school? Could an AR tools contribute positively on the inquiry-based approach of STEAM-education in general school? How to use AR tools for the inquiry-based approach of STEAM-education in general school? Answers were suggested for open-ended 3 questions, and teachers were asked to write their opinion:

- How did you use augmented reality tools for inquiry-based approach of STEAM-education?

- Which problems had you when proposed for students augmented reality tools for solving the problem?

- How helped you using augmented reality tools for displays and supports inquiry-based science education?

For the question «How did you use augmented reality tools for inquiry-based approach of STEAM-education?» the following responses were received:
- «I use AR tools to submit new material» (75%);
- «I use AR tools to present objects and processes that are difficult to show in real life» (83%);
- «I use AR tools for carrying out the brainstorm» (56%);
- «I use AR tools for testing» (27%).

For the question «Which problems had you when proposed for students augmented reality tools for solving the problem?» the following responses were received:
- «lack of methodological recommendations» (82%);
- «students' lack of understanding how to use AR tools, we must to prescribe instructions for each tools» (63%);
- «the use of many of the tools depends on the availability and quality of the Internet connection» (23%).

For the question «How helped you using augmented reality tools for displays and supports inquiry-based science education?» the following responses were received:
- «these tools help students learn about complex experiments and subjects that are difficult and expensive to explain. In addition, it provides a realistic modeling environment for the presentation of subjects such as astronomy, geography and physical sciences» (78%);
- «AR tools improve students' critical thinking, creative thinking and problem-solving skills» (68%);
- «AR tools make learning interesting, thus facilitating the learning process of students' interest and motivation» (94%).

Therefore, it is important to choose AR tools that are easy to use for students, write instructions for them, clearly explain the tasks for their use, advising students in case they do not understand the use of tools.

Conclusion. Augmented reality tools are a powerful way to improve the inquiry-based approach of STEAM-education in general school.

The ways of using the augmented reality tools for inquiry-based approach of STEAM-education in general school are: to submit new material and for brainstorm; to present objects and processes that are difficult to show in real life; for testing.

The problem of creating special courses for teachers to teach them to use augmented reality tools in professional activities for support and develop STEAM-education remains important.

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