Педагогіка вищої та середньої школи
2019. Випуск 51. С. 102–114

УДК 004.9:37.091.39

Structuring Augmented Reality Information on the stemua.science

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Abstract. It is demonstrated that one of the conditions for successful scientific and pedagogical work is exchanging of methodical materials, including with using of augmented reality. We propose to classify approaches of placing methodical materials on closed, open and open-moderated types. One of the important benefits of a closed type is the high quality of the methodical material, but it's limited by amount of material and the lack of exchange opportunities that are problems, and there are no open-moderated resources in the Ukrainian language. The aim of this article is to analyze approaches of systematization of methodical material with using of augmented reality and recommend using of STEMUA for systematization of them. It is shown that STEMUA allows teachers to develop methodical material and place it on this platform. The platform automatically organizes methodical material in the database. Consequently, the platform is satisfying the methodical needs of Ukrainian teachers for material with using of complementary reality in the teaching. It is recommended for teachers and methodists to provide development and methodical materials with using of augmented reality and add them to the platform database.

Keywords: augmented reality, systematization, methodical materials, STEM-approach of education, steamua.science.

1 Introduction

The development of educational and methodical technologies leads to the problem of systematization of methodical information. One of the modern and relevant type of information is augmented reality's (AR) developments [5]. Thus, that is necessary to develop instrument to popularize it and manage deposited information. Necessary is justified

by grooving of interest to them due its interactivity which is important to understanding of materials [6].

AR is one of the important component of STEM-approach in classes. Important for the providing STEM-approach is based on the research and engineering methods.

The scientific method includes ways to study phenomena, systematization, adjustments of new and previously acquired knowledge. The findings are made using the rules and principles of reasoning based on empirical (observed and measurable) data about the object. It's possible to research the reality using the Artificial Intelligence in the AR which can analyze the information and give some answers about object of the research to the user. Other hand, the AR can visualize the details or processes which is important to engineering method.

Scientific and engineering methods are the basis of any STEM-approach in education independently of the field of cognition. Both methods have been worked out for a considerable time and are now recognized by the international scientific community as the main means for carrying out scientific and research activities [1].

2 Literature Review and Problem Statement

However, today there is a problem of promoting and expanding the scope of the research approach. One of the reasons is the lack of information support systems for research. In other words, there is a problem with the information provision of the ways of conducting research work related to the school program and the methods that will be used to perform these works. There is a very few already worked systems based on the support such activities.

In the general approaches of deposition of methodical developments can be divided into few types: closed, open and open with moderation. Closed type of information deposit involves placing materials on online resources for only a specific group of people. At the same time, the open's provides free placement of materials without additional control. Both approaches have their advantages and disadvantages. An analysis of the advantages and disadvantages of opened, opened with moderation and closed type of placement of methodical information is presented in Table 1.

There are a lot of the systems of the open type. However, we will not pay attention on them due to lack of the control of the quality.

An example of such a system is the site http://www.sciencebuddies.org/ (Fig. 1). However, main flow of the system is English interface which can't

be used in the Ukrainian teaching. Website is designed for the student research work selection [6]. The detailed analysis of its interface and features of its operation was described in our previous works [1, 2, 7]. However, the site cannot provide the systematization of the AR materials due to the absence of separation of it. The general view of the sciencebuddies.org resource is presented on the Fig. 1.

Table 1. An analysis of the advantages and disadvantages of opened, opened with moderation and closed type of placement of methodical information

	Open	**Open with moderation**	**Closed**
Examples	An open group in social networks	Website sciencebuddies.org	Most sites ("The Future", closed group in social networks)
Main advantage	A lot of the materials	A lot of quality materials	Quality control the material
Main disadvantage	Lack of quality control of the material	Necessity of moderation	Limited amount of material

Despite the shortcomings of the closed type, it is worth pointing out that there is a platform "The Future" based on closed type of systems [3]. Main advantage of the system is Ukrainian interface and Ministry of Education and Science of Ukraine recommendation. However, "The Future" have limited amount of information and can't provide the possibility to design methodical materials of whole-Ukraine's teachers due to its closed type.

There is already known the method and tool for automatic systematization of the dynamic scientific and educational resources of the global electronic information space [number of state registration of the scientific topic 0115U000324 of Ukraine], which involves the selection of input data of information sections and the implementation of structuring the set of documents for each section separately, and for them together with Using Data Mining, Text Mining, Web Mining, and Knowledge Discovery in Databases. But it's cannot be used to organize knowledge in the educational space due to interface problems based on the old-functional instruments. However, the platform's disadvantages and the lack of support for the integration of the educational resources of the participants in the educational process.

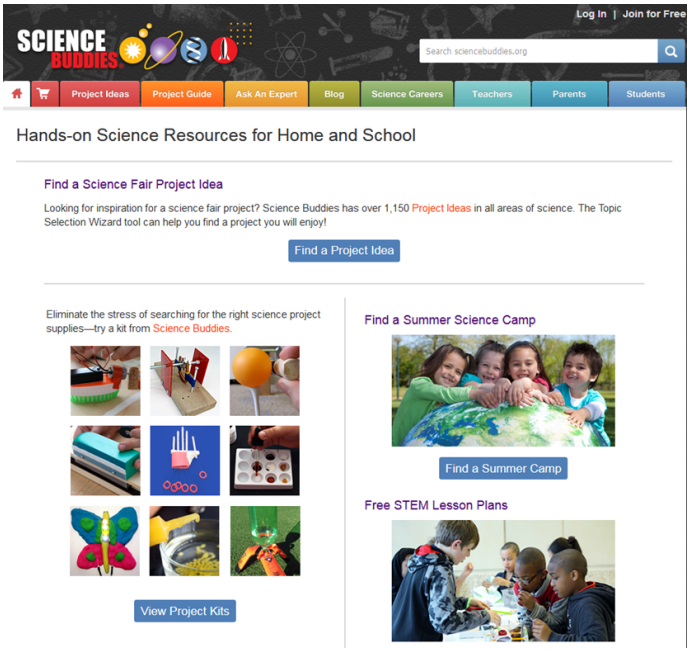

Fig. 1. The general view of the sciencebuddies.org resource

Lack of the possibility to exchanging methodical material is one of the limiting factors for the implementation of the AR in education. Thus, it is relevant to develop a platform for the placement of techniques and methods, in particular, the AR. The advantage of the first solution is its flexibility as one can choose any relevant combinations of the simulation environments, yet, their integration level is usually insufficient. The closed character of the second solution and its binding to a certain software platform make it relevant to be applied to solving various practical tasks and irrelevant for neural network simulation training as a network becomes a black box for a user. The fourth solution is partially platform-dependent as a neural network becomes a grey box for a user. The final solution is totally mobile and offers an opportunity to regard the model as a white box, thus making it the most relevant for initial mastering of neural network simulation methods.

3 The Aim and Objectives of the Study

Thus, there is the problem of storage of the methodical materials

based on the AR and that is relevant to create that system which based on the open with moderation type of systems with Ukrainian interface. We propose to use the stemua.science system (further — STEMUA) to provide informational management of the AR materials [4]. Our task was to invention the method of a functional for the dissemination and exchange of educational resources, provide a user-friendly interface for the introduction of information and visualization of it in the web interface and to ensure the systematization of the information received. This approach will allow the widespread dissemination of the virtual educational environment and, respectively, improved indexing of information. The object of study was systematization of the AR materials.

4 Development and operations of the STEMUA platform

The task was solved by creation of a new script for the template for the wordpress's the platform and for access to the editorial board of information on the wide range of educators. The participants of the creation of educational material are classified into administrators and users. Users can add their own materials and adjust them, and administrators of the information environment control the quality STEMUA content. Such an approach allows us to engage the general public in creating of educational materials.

STEMUA is the educational platform designed to provide methodical support of any activities based on the STEM-approach of education. The platform based on the TODOS instruments [8, 9]. Main page of STEMUA is present on the Fig. 2.

The site was designed to use it as a multi-agent in the ontology.inhost.com.ua system. The feature of the site is the writing of information in the form intended for reading ontology.inhost.com.ua system.

The site consists of 3 main parts:

1. Methodical cabinet;
2. Research work;
3. Methodology.

Methodical cabinet contains the theoretical foundations of STEM-education. The articles presented in this section are prepared by specialists in the field of STEM-education, in particular, employees of the NAES of Ukraine (e.g., Institute of Gifted Child).

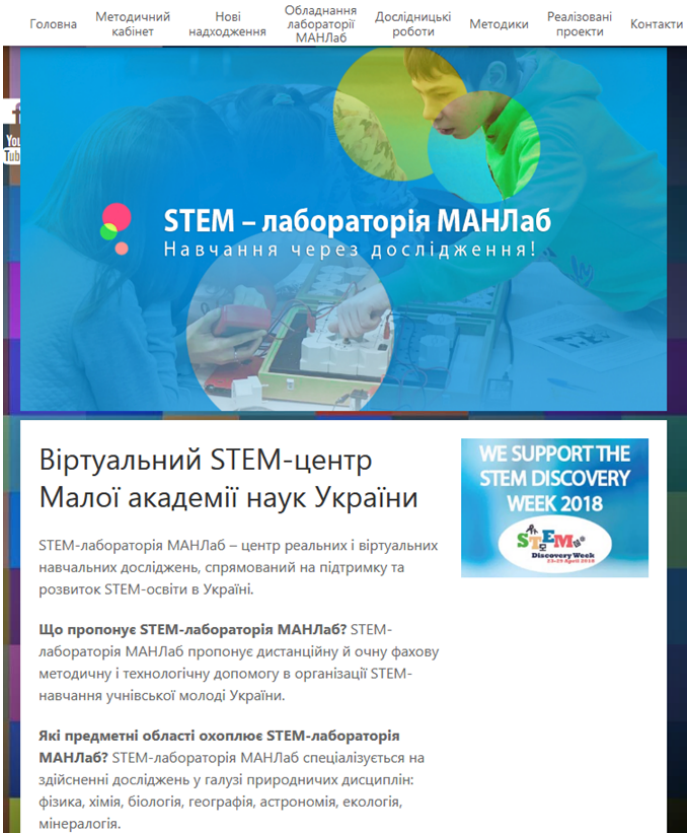

Fig. 2. Main page of STEMUA

The structure of STEMUA is consist of includes the following components:

1. Classifier of scientific instruments of technology TODOS;
2. Methodical part;
3. Catalog of research methods;
4. Catalog of techniques;
5. A tool for creating new teaching materials.

Classifier of scientific instruments based on the TODOS technology is devoted to searching and separation of the science equipment and

methodical materials. Classifier of scientific instruments of technology TODOS is present in Fig. 3.

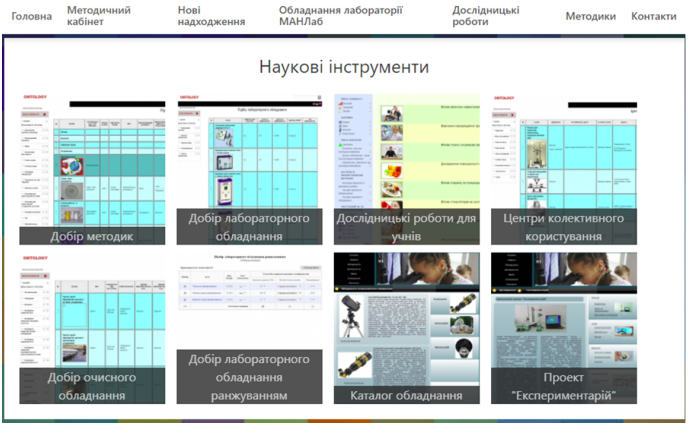

Fig. 3. Classifier of scientific instruments of technology TODOS

Methodical part is designed for information acquaintance with methodical aspects of STEM-approach in education, main concepts of education material creation using the platform and modern educational trends. The Fig. 4 is present general form of the methodical part.

The directory of research papers is a dynamically generated list of materials published on the site. Each user can add here his own research methods to share it with society. The general form of catalog of research papers is shown in the Fig. 5.

There is the mechanism of work's separation designed on the site. Both, research methods and techniques, are contain separation parameters of the educational developments. To input this parameters, there is developed the special input fields and they are:

- The author's photo and name;
- Title of the material;
- Resume material;
- A group of tags that represent the characteristics of the material;
- Material itself.

However, there will be located AR filter to faster separation the AR's developments. The catalog of techniques, also, is a dynamic list of materials with mechanisms for filtration of objects (Fig. 6).

Fig. 4. General form of the methodical part

The new material creation is provided by function "Add research work" and "Add technique" located on the user's panel. There is necessary to be registered using the Facebook, Google+ or user can create new profile to use these functions. The user's panel will be displayed after successful registration (Fig. 7).

Consider the algorithm of creating content on an example of creating a research work. The constructor of research work of technique is opens by picking the relative function on the site (Fig. 8).

The constructor contains 6 input fields and 5 fields for selecting the characteristics of the material.

The material input fields are designed simplest way to duplicate well-known Microsoft Word text editor tools. This approach is provide simple formatting of the text and even in the case of text copying from MS Word document it will be automatic formatted.

Firstly, the author of the material should to input main text of the work which consist of following parts:

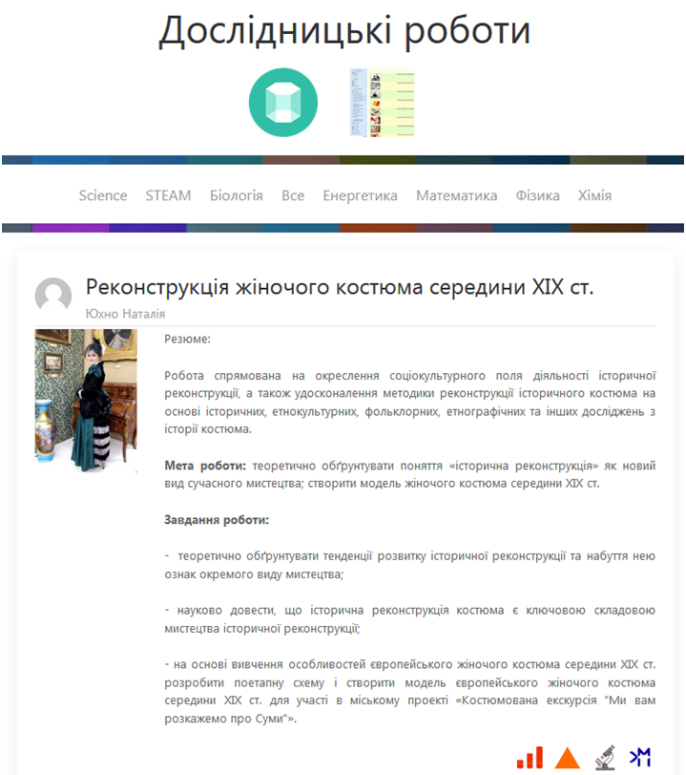

Fig. 5. The general form of catalog of research papers

- Resume;
- Preliminary information;
- Equipment;
- Experimental procedure;
- Analysis of the data;
- Areas of development (not required field).

There is necessary to input classificatory information based on the following parameters:

- Direction;
- Complexity;
- Safety;

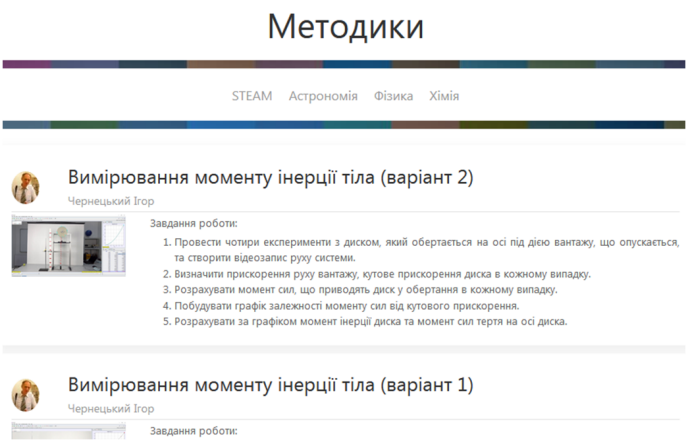

Fig. 6. View the catalog of techniques

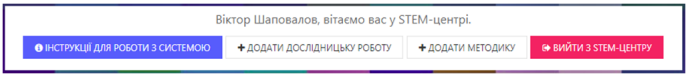

Fig. 7. View the user's panel

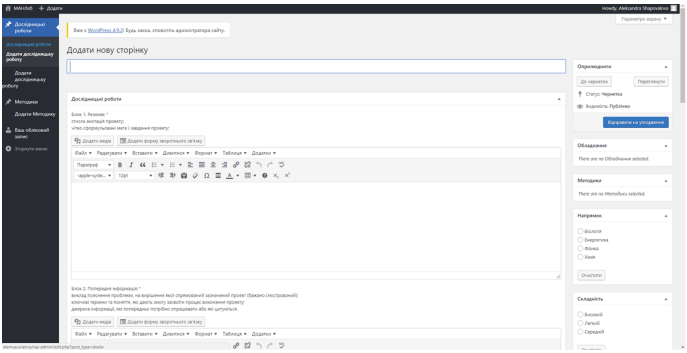

Fig. 8. The work's creating panel

- Availability of used materials;
- Work's duration.

Additionally, it may be possible to add the parameter method with the use of AR, which will allow to sort and select methodical augmented reality materials.

One of the visualized type of the systematization type is ontology

integrated to the STEMUA platform. The Ukrainian platform for ontology, developed at National Center "Junior Academy of Sciences of Ukraine", is able to perform the necessary functions and possesses a ranking tool (Fig. 9).

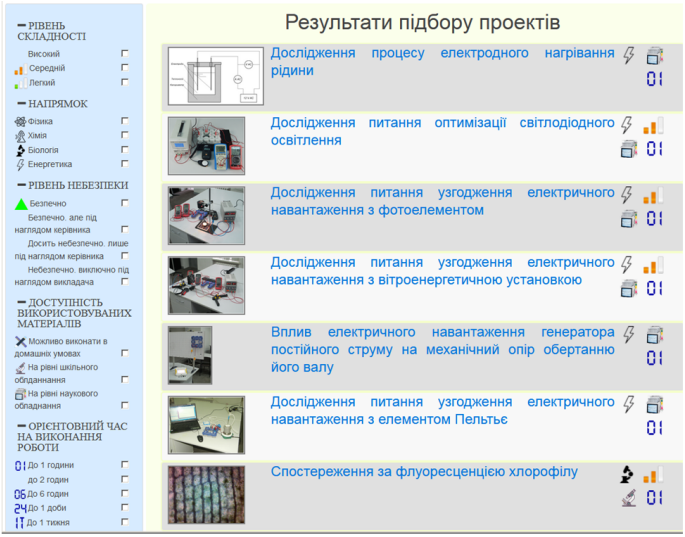

Fig. 9. Ranging platform for research work

Created the template for the WordPress site construction platform and the provision of access to editing and creating information for a wide range of participants in the educational process allows us to provide an easy-to-use interface for information entry and visualization in the web interface and to ensure the systematization of the information received.

Thus, the STEMUA platform allows teachers to develop methodical material and deposit it to the platform. Methodical materials are automatically systematized in the database of the platform, and the materials are foreseen mainly in Ukrainian, which meets the requirements of the Ministry of Education and Science. Consequently, the platform is able to meet the teachers' methodical needs regarding the use of AR in the classes.

5 Conclusions

The level of using of the AR-based methods is depends on the possibility to deposit and separate the information. There is no any instrument to

separate and manage the educational AR-oriented content. We propose to use the STEMUA system to provide informational management of the AR-based materials. The task of separate and manage the educational AR-oriented content was solved by creation of a new script for the template for the WordPress platform and for access to the editorial board of information on the wide range of educators. The participants of the creation of educational material are classified into administrators and users. Users can add their own materials and adjust them, and administrators of the information environment control the quality STEMUA content. Such an approach allows us to engage the general public in creating of educational materials. The proposed method provide easy separation of AR-material from the whole array and gives the possibility to input that information to the educational environment.

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