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TO READ OR INTERACT WITH TEXTBOOKS – WHAT IS BETTER FOR LEARNERS?

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Abstract. The introduction of digital technologies into education changes the medium and tools used to achieve the learning objectives. Traditional textbooks have to be adapted to suit to the needs and characteristics of the digital generation learners. Textbooks, combined with innovative technologies, are becoming a modern way for knowledge transfer. They engage learners and bring them new sensations and opportunities to interact with the content. The current paper presents the essence and benefits of augmented textbooks in education. An augmented textbook is presented as an example of effective use of modern technologies, combined with traditional training tools.

Keywords: augmented textbooks; interactive books; augmented reality; digital learners

Introduction

In today's society, there is a tendency to realize innovative forms of education, both technological and pedagogical, to solve the serious problems such as lack of interest and commitment on the part of the students, and poor motivation for learning.

Textbooks are one of the main tools for transferring knowledge in traditional training. Despite the vast variety of information resources, available in the Web space, textbooks remain the primary means of accessing knowledge. Unfortunately, learners often classify them as boring since there is a passive transfer of knowledge and they do not want to study with them. One possible approach to address this growing problem is to diversify traditional textbooks with new unique features (Gopalan, 2016).

In recent years, the word textbook has increasingly been preceded by various adjectives – electronic, digital, multimedia, interactive, augmented and more. Obviously, the intentions of teachers and textbook creators are to enrich this traditional educational tool, taking advantages of modern technologies. Their aim is to offer more interesting, engaging, and attractive and, at the same time, motivating learners tools for learning (Ebied, 2015). Using such tools, learners will be active participants in the learning.

Reading is a passive process of knowledge transfer. The aspiration is to make it more engaging. Technologies can turn reading into an active exercise, allow learners to interact with content, explore it in various aspects, and provoke situations that can be a source of new knowledge. (Diegmann, 2015).

The tendency is not to replace traditional books and textbooks, but to enrich them by enhancing the readers' experiences and feelings. New books have to allow readers perceive the content by all their senses and feelings (Altinpulluk, 2016). Only this approach can assure easier and quicker perception of the provided information and knowledge and create a positive attitude towards learning.

Augmented reality is one of the popular technologies nowadays, which is also rapidly entering in education. Except to developing educational applications, technology can be successfully used to create augmented books. This innovative approach is an opportunity to refine and enrich the proven traditional teaching tool – textbooks. Teachers can create such books themselves, since many platforms are available, including free ones. Some of them are easy and convenient to use and do not require special programming or 3D modeling skills.

The paper examines the evolution of textbooks and presents the nature and benefits of augmented textbooks in the learning process. As an example of effective use of modern technologies, combined with traditional training tools, it is presented a textbook "Statistical software for processing experimental data "with developed augmented reality mobile application BookStatistica.

From traditional to interactive textbooks

Traditional books (including textbooks) are a standard tool for acquiring knowledge. They can be used for both group work in classrooms and individually by learners. But digital learners are not satisfied to use the traditional textbooks, which contain only text.

Second generation e-books are known as interactive e-books. Modern information and communication technologies are an opportunity to provide enriched educational content. The textbooks are expanded with audio, video, animations, 3D models, interactive and game elements, questions with immediate feedback and more. E-textbooks may include links to various external sources, providing additional information. Learners have an access to up-to-date articles and studies of experts in different science fields. The variety of formats for presenting learning content can satisfy the preferences of a wide audience of learners, distinguished by their learning styles. A significant progress is the presence of interactivity. The idea of the interactive textbooks is to present the educational content in an easy-to-understand format and allow learners to interact with it. Interactivity has different dimensions. It may take the form of questions about the textbook content. Depend-

ing on the answers given by learners, a specific feedback is provided and different sequential content is offered to them. The interactivity allows learners and teachers to highlight sections of the textbook, specific paragraphs or words, collaboratively create and share comments, notes, bookmarks to content, search for unfamiliar terms in interactive dictionaries, conduct debates in discussion forums, etc. (Murray, 2011), (Embong, 2012).

One of the major advantages of e-books are the dynamic update of the content, non-linear navigation, search and markup capabilities (Lim, 2011).

With such properties, the e-textbooks allow realization of the learning process where learners are active participants and accumulate rich learning experience. The interactive e-textbooks increase learners' interest and motivation to read and learn.

Of course, e-textbooks are not the perfect tool for delivering educational content. One disadvantage is the need for special technical and software tools to make the content accessible to readers. Often the screens of the devices are small and the content is difficult to read. The limitations on memory and computing power can also have negative effects (Embong, 2012).

Augmented books

The augmented book can be described as the next step in their evolution. The new technologies such as Augmented and Virtual Reality cause their changing effect on the development of e-books.

(Azuma, 1997) defines Augmented Reality as a system where real and virtual objects are combined and exist together at the same time, in the same place. The virtual objects are registered in the physical 3D world and there is a geometric alignment with the real objects in the real world. Users can interact with the virtual content, which in turn responds to their actions and there is a real-time interactivity.

Augmented reality is a technology that expands and enriches the physical world with layers of virtual information about real objects. In this sense, Augmented Reality complements the physical world, instead of replacing it.

An augmented book is a traditional (paper) book with added virtual content that is available through appropriate hardware and software tools (Altinpulluk, 2016). The augmented books enhance traditional ones with interactive visualizations, animations, 3D models, audio and video. This enriches reading and is a prerequisite for engaging readers' experience (Dünser, 2012).

The idea of augmented books is more extensive and they have significant advantages over other e-textbooks. They can be read as traditional books, and at the same allow access to additional interactive digital content. There is no need to buy special equipment to read them, because learners use devices that they employ in their daily lives – mobile phones and tablets. The augmented textbooks allow learners to interact with virtual content, to explore and experiment, which guarantees active learning, better and easier perception and comprehension of complex and abstract

concepts. They deepen the students' interest, commitment and motivation. The augmented books can have a positive impact on students' achievement and attitudes toward their own learning (Lim, 2011).

Related works

Many commercial augmented books are available. Their main purpose is to make reading interesting and motivating. Most of them are for young children, because with technology, a simple book becomes "magical" by incorporating 3D models and gamification elements (Altinpulluk, 2016).

There have been a number of successful examples of augmented textbooks in different subjects. One of the most commented is the Magic Book that provides both Augmented and Virtual reality experience for readers. Everyone can see the others as miniature figures, avatars or virtual heads (Billinghurst, 2001). A combination of Augmented Reality Interface and Tangible User Interface is used in Live Solar System to provide seamless interaction to users when they explore and study the sun and the planets in the solar system (Sin, 2010). (Dünser, 2012) developed the augmented books to teach the concepts of magnetism. In textbooks in addition to text, there are diagrams, which are used as tracking markers, and animated models to demonstrate how magnets work. The Ethnobotany Workbook contains unique markers (black and white barcode images) that, after scanning, display 3D interpretations of different plant species (McGrath, 2011). With Imagina Books: Human Body learners study human organs and systems through realistic models and elements of gamification. The purpose of Augmented reality book in Cutting tools is to accomplish attractive blended learning. Students learn about the design and geometry of cutting tools, their technological capabilities and conditions for using through interactive 3D visualizations and simulations, animations and movies (Ivanova, 2014).

Augmented Statistics textbook and BookStatistica mobile application

Considering the advantages of augmented textbooks over paper ones, the idea comes to life – to create a traditional statistics textbook enriched with markers that allow access to additional virtual interactive content.

"Statistical software for processing experimental data" is a traditional textbook on Statistics. It includes an overview of statistical resources and software packages, examination of the nature, object and tasks of statistical methods, a comparison of statistical software, presentation of descriptive and inferior methods with selected statistical products. The mobile augmented reality application BookStatistica is a complement to the traditional paperback textbook. It allows readers to scan markers and access different resources in various formats.

Implementation

The mobile application BookStatistica was developed with Unity and Vuforia Engine (Figure 1). At this time, the application can run only on Android platform, but the idea is soon to be ready for iOS.

Figure 1. The welcome screen of BookStatistica app

Unity is a game engine and can be used to create 2D and 3D games, games with Virtual and Augmented reality, simulations and so on[1].Vuforia Engine is a platform for creating Augmented Reality apps. They can recognize images and objects, and allow users to interact with virtual objects in the real world[2)].

The process of development of application includes several steps. First, the scenes that contain the environments and menus of the application are created. Vuforia AR Camera is added to one of them and it acts as the camera on the device (or webcam on the computer).

Second, database with image targets, used as markers in marker-based tracking, is created in Target Manager in Vuforia platform and imported into Unity project. The default way Vuforia works is with Image Recognition. Image Recognition is the process by which the device's camera detects and recognizes an image target and renders virtual content over the position of the marker in the camera view[3,4)].

Third, the virtual buttons, as the components in the User Interface system that handles interaction, are designed. They initiate actions when the user clicks them. To respond to users' inputs and actions and arrange events in the application scripts in C# are created.

All additional learning resources (video materials and animations), visualized after scanning markers, are stored and shared using Google cloud services.

The textbook "Statistical Software for the Processing of Experimental Data" includes markers for various purposes. Some markers refer learners to external additional sources of information – for example, Web sites for data visualization or online statistical processing. This is a very convenient way to deliver more content to learners since there are many available resources for statistical data analysis that cannot be systematized into a single textbook.

After scanning other markers, video materials are launched. Learners can see the demonstration of statistical methods or the interactive capabilities of a given statistical product.

There is an opportunity to download the data files, used in the examples, by scanning a marker (Figure 2). Learners can use real data to experiment with different data processing on their own. Another marker redirects readers to a forum where they can discuss issues and share ideas related to statistical data processing (Figure 2).

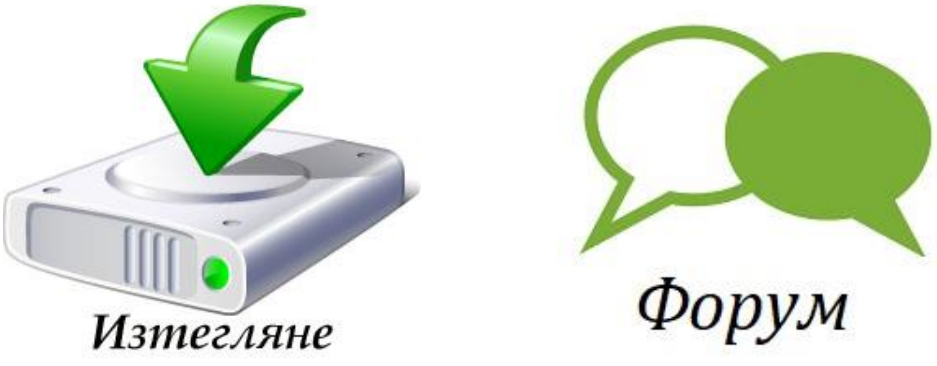

Figure 2. Markers for downloading data files and accessing discussion forum

There are markers (Figure 3) that display virtual buttons in camera view (Figure 4). They allow users to interact with virtual content. With virtual buttons, learners can choose with which statistical product to view the implementation of the statistical procedures in the form of video material. These markers are available for each method of data analysis.

Figure 3. A marker in textbook

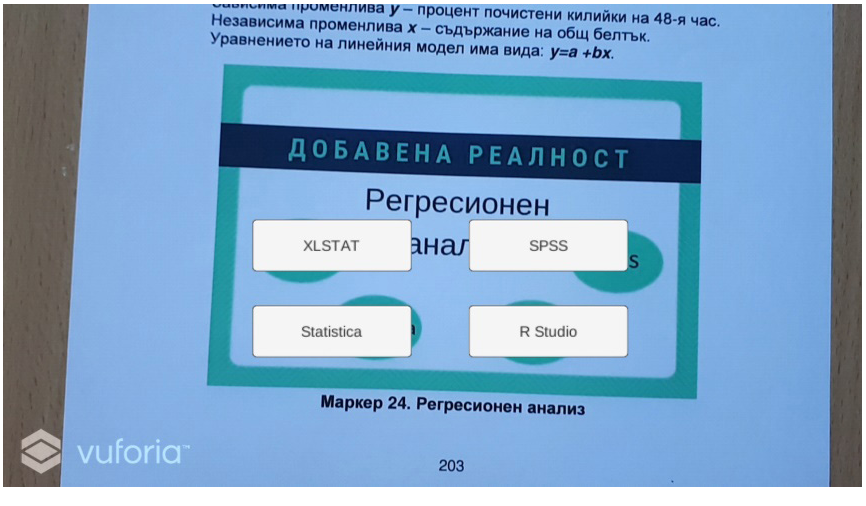

Figure 4. Virtual buttons on the device screen

Potential benefits and educational effects

The augmented textbook can be used as a traditional book without the need of any technical and software tools. Augmented reality enriches the traditional text-

book and provides learners with a new perspective on existing theories and concepts, making reading an interactive process. The developed augmented textbook creates conditions for easier and intuitive understanding of complex and abstract concepts of probability theory and statistical data analysis.

Augmented reality allows adding information and materials that exceed the curriculum requirements. With augmented textbook learners can deepen and expand their knowledge.

The statistical procedures are illustrated with video materials, which is the preferred format by learners. They can choose which statistical product to illustrate the data analysis method under consideration. Most of the results of analyses (tables or graphs) are interactive. Through Augmented Reality, they can be presented and analyzed visually, thus avoiding long verbal descriptions. The elements of interactivity engage learners and give them freedom of choice.

Learners have an access to data files and can use them for their own experiments and analyzes. Such an approach gains them experience and confidence in statistical data processing.

Conclusion

Traditional textbooks are static tools for knowledge transfer and learning that is a major drawback for today's digital learners. Augmented textbooks are a combination of innovative technologies (Augmented reality, cloud and mobile technologies) and traditional tools (textbooks). The use of modern technologies allows the content to come to life and gives learners opportunities not only to read it but also to interact with it. Reading becomes a fun, engaging and active process that enable a research-based approach in learning.

A significant advantage of augmented textbooks is that they can be read in the traditional way and contain everything needed to acquire knowledge. An extra bonus is the ability to access additional materials in various formats, the presence of interactive elements, animation, 3D models, available due to Augmented reality technology.

Any traditional textbook can be improved with additional content by incorporating augmented reality markers. Thus, from the traditional means of unidirectional transfer and passive perception of predominantly theoretical knowledge, textbooks are becoming interactive, engaging, dynamic and interesting learning environments.

E-textbooks cannot completely replace traditional textbooks. This is not necessary because they are a well-established tool that produces positive learning outcomes. Their change in the direction of enrichment and improvement is imperative in order to become an interesting and motivating tool for learners. Combining traditional educational tools with new technologies is the best way to ensure a balance between traditional and innovative and achieve the desired positive learning effects.

NOTES

1. Wikipedia, https://www.wikipedia.org/–last access 09.08.2019
2. Vuforia Developer Library, https://library.vuforia.com/– last access 09.08.2019
3. Unity Tutorials, How to Make an AR Game Using Vuforia, https://www.raywenderlich.com/6120-how-to-make-an-ar-game-using-vuforia– last access 09.08.2019.
4. Unity User Manual (2019.2), https://docs.unity3d.com/Manual/– last access 09.08.2019

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REFERENCES

Altinpulluk, H. & Kesim, M. (2016). The Classification of Augmented Reality Books: A Literature Review. *INTED 2016 Proceedings, pp. 4110 – 4118*.

Azuma, R. T. (1997). A survey of augmented reality. *Presence: Teleoperators & Virtual Environments, 6(4), 355 – 385.*

Billinghurst, M., Kato, H. & Poupyrev, I. (2001). The magic book-moving seamlessly between reality and virtuality. *IEEE Computer Graphics and applications, 21(3), 6 – 8.*

Deuter, M., Bradbery, J. Turnbull J. (2015), *Oxford Advanced Learner's Dictionar*y, Oxford University Press, ISBN: 9780194798792

Diegmann, P., Schmidt-Kraepelin, M., Eynden, S. & Basten, D. (2015). Benefits of augmented reality in educational environments-a systematic literature review. *Benefits,3(6), 1542 – 1556.*

Dünser, A., Walker, L., Horner, H. & Bentall, D. (2012). Creating interactive physics education books with augmented reality. *In Proceedings of the 24th Australian computer-human interaction conference (pp. 107 – 114). ACM.*

Ebied, M. M. A. & Rahman, S. A. A. (2015). The Effect of Interactive e-Book on Students' Achievement at Najran University in Computer in Education Course. *Journal of Education and Practice, 6 (19), 71 – 82.*

Embong, A. M., Noor, A. M., Hashim, H. M., Ali, R. M. & Shaari, Z. H. (2012). E-Books as Textbooks in the Classroom. *Procedia-Social and Behavioral Sciences, 47, 1802 – 1809.*

Embong, A. M., Noor, A., Ali, R., Bakar, Z., & Amin, A. (2012). *Teachers' perceptions on the use of e-books as textbooks in the classroom*. World Academy of Science, Engineering and Technology,70, 580 – 586.

Gopalan V., Zulkifli A. N., Mohamed N., Alwi A., Mat R., Bakar J. & Saidin A.(2016). Augmented Reality Books for Science Learning-A Brief Review. *International Journal of Interactive Digital Media. 4, 6 – 9.*

Ivanova, G., Aliev, Y. & Ivanov, A. (2014). Augmented reality. Textbook for future blended education. *In Proceedings of the International Conference on e-Learning (Vol. 14, pp. 130 – 136).*

Lim, C. & Park, T. (2011). Exploring the educational use of an augmented reality books. *In Proceedings of the Annual Convention of the Association for Educational Communications and Technology (pp. 172 – 182).*

McGrath, R. E., Craig, A. B., Bock, D. & Rocha, R. (2011). *Augmented Reality for an Ethnobotany Workbook*. Illinois Research and Scholarship (Open Community)

Murray, M. C. & Pérez, J. (2011). E-textbooks are coming: Are we ready? *Issues in Informing Science and Information Technology, 8 (6), 49 – 60.*

Sin, A. K. & Zaman, H. B. (2010, June). Live Solar System (LSS): Evaluation of an Augmented Reality book-based educational tool. *In 2010 International Symposium on Information Technology (Vol. 1, pp. 1 – 6). IEEE.*

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