Developing of Key Competencies by Means of Augmented Reality in Science and Language Integrated Learning

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Abstract. Using of new learning and IC technologies is necessary for effective learning of modern students. That is why it can be reasonable to introduce augmented reality and content-language integrated learning in educational process. Augmented reality helps create firm links between real and virtual objects. Content and language integrated learning provides immersion in an additional language and creates challenging group and personal tasks in language and non-language subjects. Using these technologies in complex provides social and ICT mobility and creates positive conditions for developing 9 of 10 key competencies. The paper deals with the features, problems and benefits of these technologies' implementation in secondary schools.

Keywords: Augmented Reality, Science Learning, Key Competencies, Generation Z, Content and Language Integrated Learning (CLIL).

1 Introduction

Current secondary school students are members of "Generation Z" cohort (according to Strauss and Howe). ICTs and social media are the essential parts of "Zeds" world. So using ICTs in education is not an option but a necessity. The most helpful educational technologies for "Zeds" are smartboards, digital textbooks, websites, online videos and game-based learning systems. [1, pp. 6-8]. That is why we have to create dynamic learning environment, which contains modern ICTs as its inseparable part.

2 Using Augmented Reality in Science Learning

Jean-Marc Cieutat, Olivier Hugues and Nehla Ghouaiel define AR as the combination of physical spaces with digital spaces in semantically linked contexts for which the objects of associations lie in the real world [2, p. 32]. According to Gartner hype cycle analysis AR is a mature technology [3] and is going to be widely used in different spheres of our lives (including education).

The main benefits of using AR are connected with studying objects and phenomena, which are inaccessible for direct cognition, but can be observed by means of AR. It can be very useful in learning abstract Math and Science concepts. AR shows the links between real and virtual objects. Moreover, AR can be a good example of developing technology by itself. At schools AR can form some "digital" habits which can be useful in future life. Using AR in a classroom makes it possible to learn in a personal-oriented environment. It helps students to provide their own learning styles. According to The State Standard of the Basic and Complete Secondary Education there are 10 key competencies [4]. The benefits of using AR in secondary schools are given in the Table 1.

Table 1. Advantages of using AR at science lessons (in regard to key competencies).

Competency	Component of Competency			
	Cognitive	**Skills and Experience**	**Values**	**Social and Behavioral**
Mathematical Competency	supporting of abstract mathematical concepts learning	scaffolding of basic math skills (i. e. geometry imagination)	giving an example how maths equations come to life	making better conditions to provide own learning style
Competencies in Science	supporting of abstract concepts learning; improving links between nature objects and phenomena	making possible to operate with objects, which are inaccessible for direct cognition	demonstrating science implementations; motivating for science learning	making better conditions to provide own learning style
Digital Competency	widening outlook; getting knowledge about AR	mastering subjectively new technologies	demonstrating the importance of digital literacy	mastering new ways of digital learning communication
Lifelong Learning	demonstrating infinite technological progress	getting new learning habits	demonstrating entertaining and useful learning potential	mastering new ways of learning communication
Sense of Initiative and Entrepreneurship	gaining knowledge about effective ways of organizing information	getting experience of applying the same technology in different fields	helping to adapt to constantly changing situations (using an example of AR)	mastering new effective ways of communication
Cultural Awareness	mastering new effective ways of gaining cultural knowledge	improving praxeological component of technical awareness	making cross-cultural links more obvious	giving opportunities for creating own style of self-development
Ecological Competencies and Health Care	helping to understand the complexity of ecological and medicine processes	acquiring skills and getting experience of health care by themselves	helping to understand links between nature phenomena and human activities	making better conditions for creation of own health care programme

The most essential drawbacks of using AR are connected with deficient studies of its influence on user's health and a lack of privacy and security [5]. We should say that the last problem is mainly caused by irresponsible using of AR; it is not AR itself. That is why it is especially important to teach students basics of AR using (including safety regulations). One of the difficulties, which we face applying AR at Ukrainian secondary school, is their English interface. We can overcome this drawback by developing foreign language competency.

3   CLIL Approach In Education

Content and Language Integrated Learning (CLIL) is a modern approach to the developing of foreign language competency [6]. CLIL is a dual-focused educational approach in which an additional language is used for the learning and teaching of content and language with the objective of promoting both content and language mastery to pre-defined levels [6, pp. 2, 65]. Advantages of CLIL approach (in regard to key competencies [4]) are reflected in the table 2.

Table 2. Advantages of CLIL science lessons approach in key competencies forming.

Competency	Component of Competency			
	Cognitive	Skills and Experience	Values	Social and Behavioral
Foreign Language Competency	cross-subject vocabulary	real learning situations; providing more language practice	wider access to science sources; using languages for practice	mutual assistance in learning; more accessible social environment
Mathematical Competency	learning specific terms in a foreign language	learning culture-based math rules (e.g. mnemonics)	realizing the impact of math on learning mobility	empowering social interaction in learning math
Competencies in Science	a variety of learning objects and sources; learning terms in English	learning culture-based science rules (e. g. mnemonics)	understanding the importance of science for learning mobility	empowering social interaction in learning science
Lifelong Learning	cross-subject links; opportunities to work with various resources	acquiring skills of "mining" knowledge in different languages	increasing awareness in different branches of learning	forming collaboration habits in learning English and science
Social and Civic Competencies	developing better cross-cultural understanding	shaping tolerance and respect to other cultures	showing an impact of all cultures on science	broadening social experience
Sense of Initiative and Entrepreneurship	providing a wider range of resources	broadening teamwork experience	showing the personal input in common success	mutual assistance in learning English and science
Cultural Awareness	widening outlook	widening a range of multilinguistic activities	revealing the value of different knowledge areas	enhancing ability to reflect cultural diversity

The backgrounds of CLIL lessons are: proper level of students' language skills, parents' and students' demands for social mobility, the teachers' readiness to introduce CLIL lessons and social competency of all educational process participants. Introducing CLIL lessons faces such difficulties as curriculum coordination, consuming a lot of time to prepare a CLIL lesson and a lack of appropriate resources. Taking into consideration both recent researches [6] and our practical experience we can conclude that CLIL lessons are more interesting, motivating, time-saving, help students to feel confident, promote communication, provide educational diversity and increase mobility.

4   Conclusions

Nowadays new learning and IC technologies are required to satisfy "Zeds" demands. For instance, all reviewed technologies provide individual learning strategies. The using of both AR and CLIL helps to form and develop 9 of 10 key competencies (except native language competency). Augmented reality helps to create the firm links between real and virtual objects. Content and language integrated learning creates conditions for efficient group and individual work in language and science learning.

Implementation of these technologies is reasonable only under certain conditions: gadgets and appropriate level of teachers' digital literacy (for AR) and the proper level of foreign language competency (for CLIL). The main difficulties, we face applying these technologies in science learning, are connected with organization of educational process not with teaching or learning. AR and CLIL technologies together create rich learning and teaching environment for effective education of modern students.

References

1. Barnes & Noble College : Getting to Know Gen Z – Exploring Middle and High Schoolers' Expectations for Higher Education, (2017), https://www.bncollege.com/Gen-Z-Research-Report-Final.pdf, last accessed 2018/01/29.
2. Cieutat, J.-M. Hugues, O., Ghouaiel, N.: Active Learning based on the use of Augmented Reality Outline of Possible Applications: Serious Games, Scientific Experiments, Confronting Studies with Creation, Training for Carrying out Technical Skills. International Journal of Computer Applications 46(20), 31–36 (2012).
3. Technology Research | Gartner Inc., http://www.gartner.com, last accessed 2018/01/29.
4. The State Standard of the Basic and Complete Secondary Education, The Cabinet of Ministers of Ukraine, http://zakon3.rada.gov.ua/laws/show/1392-2011-%D0%BF (in Ukrainian), last accessed 2018/01/29.
5. Roesner, F., Kohno, T., Molnar, D.: Security and Privacy for Augmented Reality Systems. Communications of The ACM 57(4), 88–96 (2014).
6. Marsh, D.: CLIL/EMILE - the European dimension: actions, trends and foresight potential. Jyvaskyla University, Finland (2002).