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# INQUIRY-BASED LEARNING "OUTSIDE" THE CLASSROOM WITH VIRTUAL REALITY DEVICES

**ABSTRACT**

*In the inquiry-based learning (IBL) students are those who construct the knowledge because they are more engaged and more interested in. In most of the cases IBL requires field trip activities, i.e. visiting places physically outside the classroom with main purpose observation for education. One of the top latest technology hit are virtual reality (VR) devices which provide new media experiences and bring VR content. IBL can benefit from this new technologies by using its highly immersive multimedia, the students will be able to go "outside" the classroom and they will be able faster to collect IBL-data they need, to enjoy the learning process, and to acquire new knowledge in very engaging way. Research with three different devices which offer three different type of VR experience have been done. Some brief actual conclusions about the devices' advantages and disadvantages have been pointed out. Based on this brief VR research, the paper presents a few possible applications of VR technologies in class, which expects new, enriched IBL process. Planned future steps are designing of IBL with VR devices, i.e. development and testing of VR scenarios. These steps aim VR adoption in the classroom with main purpose improvement of students' learning outcomes.*

**KEYWORDS**

*Inquiry-based learning; virtual reality; VR.*

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# ОРИЕНТИРОВАННОЕ НА ВОПРОСЫ ОБУЧЕНИЕ «ВНЕ» КЛАССА С ИСПОЛЬЗОВАНИЕМ УСТРОЙСТВ ВИРТУАЛЬНОЙ РЕАЛЬНОСТИ

**АННОТАЦИЯ**

*При применении обучения, ориентированного на вопросы (Inquiry-Based Learning, IBL), студенты лучше получают знания, потому что они больше вовлечены и заинтересованы в процессе. В большинстве случаев подход с ориентацией на вопросы требует проведения экскурсий, посещения мест физически за пределами классной комнаты, с целью наблюдения за предметом изучения, в ходе образовательного процесса. Устройства виртуальной реальности - одна из популярных современных технологий, предоставляющая новые возможности для подачи медиа-контента как содержимого виртуальной реальности. Процесс обучения с ориентацией на вопросы может извлечь выгоду из этой технологии, используя вовлекающие мультимедиа-презентации. Также с помощью технологий виртуальной реальности студенты могут выйти "за пределы" классной комнаты и быстрее накапливать необходимый опыт, получать удовольствие от процесса обучения, приобретать знания в увлекательной форме. Было проведено исследование с тремя различными устройствами, которые предлагают три различных подхода к получению опыта виртуальной реальности. Были сделаны краткие фактические выводы о преимуществах и недостатках каждого подхода. В докладе представлено несколько возможных применений технологий виртуальной реальности в классах, которые ожидают новый, усовершенствованный процесс обучения. В будущем планируется создание образовательного подхода с применением устройств виртуальной реальности, развитие и тестирование сценариев в виртуальной реальности. Данные шаги направлены на внедрение виртуальной реальности в процессе обучения, с основной целью улучшить результаты обучающихся.*

**КЛЮЧЕВЫЕ СЛОВА**

*Inquiry-based learning, ориентированное на вопросы обучение, виртуальная реальность, VR.*

## Introduction

Inquiry-based learning (IBL) researches can be deeper and more extensive if they are done outside the classroom. They often take a place outdoors, in specially equipped places, and not rare in a very special environment where not everybody is allowed to enter (e.g. medical operations [1]. Sometimes students, who are the researchers during the IBL process, want their research to take a place at locations physically far (different building, town, country, continent) or out of reach (e.g. mountains, underwater depths [2] or being in a plane and watching plane lining up, taking off, approaching and landing from inside the cockpit [3], etc.). Now by using virtual reality (VR) devices wide range of researches can be very easily done, physically right in the classroom but virtually "outside" the classroom, somewhere else, because these new technologies offering VR environment, which can be truly immersive.

This article is divided into three main parts. First part presents three VR approaches and do comparison of three VR devices each of three approaches uses. Second part suggests VR successfully can be applied in IBL process and VR can be applied in education, recent good practices for using VR in class are presented. Third part outline some main VR challenges. In the end of the article are made conclusions and plans for further researches.

## Virtual Reality Approaches

There are three approaches to providing VR according to L.E.K. [4]: (1) *Super VR* - dedicated display built into headset (2) *Medium VR* - split-screen smartphone display used by headset / viewer; (3) *Casual Mobile VR* - smartphone-only VR, tablet-only VR VR. Based on this VR approach classification, a little research and comparison have been done (Table 1). The devices used for the research are Oculus Rift DK2 (Figure 1) – *super VR*, Google Cardboard version 1 [5] –*medium VR*, and smartphone (Samsung Galaxy SIII mini) and tablet with VR applications (apps) and 360° videos – *casual mobile VR*.

*Table1. Comparison of different VR approaches (as of 15/10/2016)*

| № | VR Approach | Devices needed | | |
|---|---|---|---|---|
| | | VR Device | | Other devices |
| | | Name | Price (Euro) | |
| 1 | **Super VR** | Oculus Rift DK2 headset | 270 | Powerful computer |
| | | Oculus Rift headset | 550-750 | Powerful computer; controllers and earphones (optional) |
| 2 | **Medium VR** | Google Cardboard v1 viewer | 0-13 | Smartphone capable to run VR apps, VR 360° videos |
| 3 | **Casual Mobile VR** | Not needed | - | Smartphone / Tablet capable to run VR apps, VR 360° videos |

Based on the comparison described above in Table 1, easily can be concluded at present moment most affordable approaches providing VR are medium VR and casual mobile VR.


*Figure 1. Super VR: Oculus Rift DK2 [6]*

## Virtual Reality in the Inquiry-Based Learning

What is one of the key prerequisites for the fruitful and effective IBL? In order for inquiry to be effective, a teacher must lay a foundation in which students can begin to take more responsibility for their own learning. He must create a rich physical environment in which children learn how to organize and manage materials [7]. And nowadays with the presence of VR technologies, he also can be able to provide students with rich virtual environment.

Grabbing and using these high-tech technologies in class can take students on the field trips

"outside" the classroom, the IBL process may become more lively and attention-grabbing right in the classroom.

Integrating technologies to class could add to the learning experience, could add value to the activities. VR can be integrated with:

- Literature - field trip to the writer's homeland;
- Biology - field trip under the water;
- Physics – field trip to the Space;
- Math - visit the Great Wall of China to calculate how long it would take to walk the length of the wall
- Foreign language - to describe landscapes;
- Etc.

VR can be integrated with almost every subject in school or university. We tested Casual Mobile VR approach and Medium VR approach, respectively in subjects Biology and Interior Design, and how these approaches can be used in class. Below are the examples:

1. *Integration with Biology* - by using appropriate tablet (Figure 2) it is tested Casual mobile VR approach. What Happens Inside Your Body? - VR 360° video [8] was the 360° video played on the tablet. The video is part of animated educational series. Possible scientific questions that could be raised by the teacher are: What the respiratory system consist of? Which are the main organs?;


*Figure 2. Casual Mobile VR: Tablet running VR 360° video*

2. *Integration with Interior Design* class - by using smartphone with mobile operating system Android, Cardboard application installed (Figure 3) on it and set to work with the Google Cardboard v1, Planner 5D application (Figure 3) installed on the device (application for creation of home design and interior décor) was tested Medium VR.

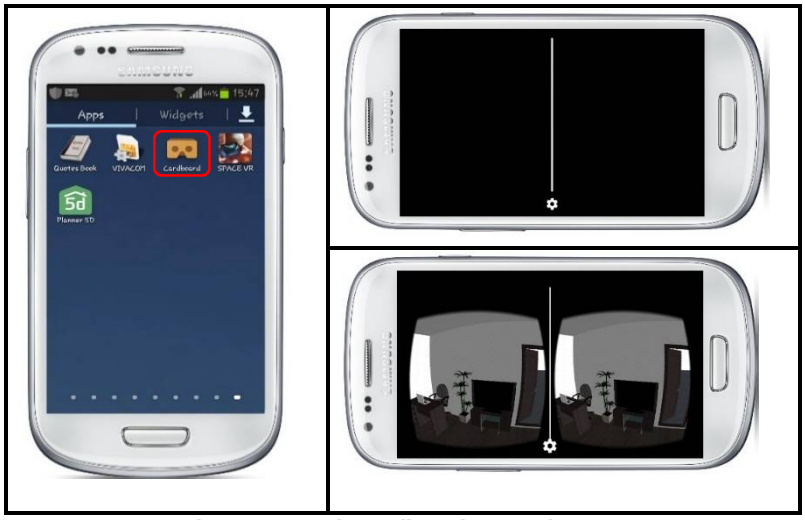


*Figure 3. Medium VR: Google Cardboard App and Stereoscopic View*

With this application users are able to create home design and interior décor, make photorealistic HD 3D renders and visualizations on desktop and later to run them in VR environment with VR viewers Google Cardboard (Figure 3, 4).

*Figure 4. Medium VR: Google Cardboard and its usage in practice*

*Google Expeditions* is a very good example put into practice for VR application in IBL process because enable teachers to bring students on virtual field trips to places like museums, underwater, and outer space. Expeditions are collections of linked VR content and supporting materials that can be used alongside existing curriculum. These trips are collections of virtual reality panoramas — 360° panoramas and 3D images — annotated with details, points of interest, and questions that make them easy to integrate into curriculum already used in schools. Google is working with a number of partners to create custom educational content that spans the universe.

Expeditions are group experiences (Figure 5) with a guide leading (teacher) and the explorers (students) following along. Google recommend a tablet for the guide and phones with Cardboard, a virtual reality viewer (Figure 4), for the explorers [9].

*Figure 5. Google Expeditions in class [10]*

**Challenges with VR**

At this point, there are some difficulties and possible obstacles in using VR devices in the classrooms. They are based on the research with the three approaches for providing VR, and are listed below:

- need of a powerful device - PC (for using Oculus Rift, for example [11]), smartphone/tablet whenever downloading and/or using big VR software;
- need of specific device (for example: specific smartphones needed to use Samsung Gear VR [12]);
- problems with the lenses when using VR headsets/goggles, bad quality of the images, mainly glass wearers could experience it (Oculus Rift and Google Cardboard);
- VR takes more time to load due to slow internet connection, so strong and stable Internet connection is highly recommended or availability of offline materials;

- Cybersickness - examples of cybersickness symptoms include nausea, eye strain, and dizziness [13];
- etc.

**Conclusion and Future Steps**

In the presented brief scenarios and in the Google Expeditions in section 3, the teacher and the students use ready prepared VR content. Since now the variety of educational content is still rather narrow. A very important fact is that the future of VR technology depends on VR content, content that creators are going to develop for this new virtual world.

Now it is the right time educators and researchers to think and to plan how to manage with the obstacles and the present challenges about VR adoption in the classroom, how to harness VR technologies for making the education more engaging, more enticing, and very important much more effective. VR technologies are going to enter our lives more, and more, they are going to affect mostly to the lives of today's digital generation students. Hence adoption of VR technologies in the classroom means also applying them in the IBL process, simultaneously improving it. This could lead to increase students' interest in studying.

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