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REVIEW

Enhancing Primary School Teaching through Virtual Reality

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ABSTRACT

In this day and age, the usage of computers as well as Internet combined with mobile devices is an integral part of our routine especially for adolescents and younger children. Thus, it puts forward a multitude of challenges and advances for educational institutions. The purpose of this article is to explore the current use of virtual reality in order to support teaching and learning along with presenting a teaching proposal concerning the utilisation of CoSpace Edu software on the subject of Religious Affairs.

1. Introduction

In development platforms, Augmented Reality, or AR for short, as well as Virtual Reality, or VR for short, were referred to as the "fourth wave." In both business and educational contexts, personal computers, Internet, and mobile apps, AR and VR applications are now taking their place. AR and VR have, as if their predecessors, changed the way we connect and interact with people and the world around us [1].

Advances in the field of technology and computing have brought about the need for a shift in the paradigm of teaching. Therefore, educators should take advantage of the familiarisation of youngsters with gaming and applications [2] so as to incorporate VR in the classroom. If we were to provide a definition of VR, we could highlight that it is the experience through which although users enter a virtual world comprised of 3D objects through the use of a headset attached to a computer or mobile device, they still preserve their physical presence in the real world [3]. What is more, within such a simulated environment differentiated feedback is generated and it could be auditory, visual, haptic and sensory. In order for an application to be regarded as VR, it should exploit 3D, real or fictional models of objects. Another trait is that head movement and adjustment of view on the part of the user are prerequisites.

The origins of contemporary VR date back to 2012 when Oculus Rift was initiated and introduced into the market in order to offer a more cost-effective high-quality Head-Mounted Display (HMD) to the potential consumers. Therefore, prior to the official launch, a variety of models was developed in order for a number of applications to be developed [4]. According to[5], the use of a head-mounted device dwindles the user's surrounding reality and provides a shift to another environment.

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2. VR in Education

Technologies aiding teaching and learning have been in the spotlight for the past decade. Except their application in gaming, increased interest has been shown in the use of such technology in educational contexts. On the grounds that it opens up a window to a whole new array of differentiated learning experiences [6]. Virtual reality is broadly applicable. It is currently being applied to areas of education including natural science, technology training, history, architecture and medicine. In education, virtual reality has found a new area in which to showcase its full potential [7]. The learning methodologies that have the greatest effect on current educational systems are those that present students with a specific problem they have to solve using acquired theoretical knowledge or through improving students' capacities that are non-existent or underdeveloped until that moment.

The particular situation can be programmed through virtual reality technology with several variables and environments on which the student can act. Applications can be customised to suit every subject, knowledge area, population segment or geography [8]. Access to information would be more inclusive thanks to those kinds of technologies. Students struggling to meet certain learning goals with a poor success rate should now be able to effectively reach the goals.

Another major area where virtual reality is providing a more than significant value is in the representation of abstract concepts [9]. Laboratories completely simulated through this technology allow interaction between the student and the devices [10]. Taking this analysis further, the cost savings in space would be huge. The underutilized space within the centers would be significantly reduced and would be replaced by "multi-laboratory" room in which, according to the subject, one laboratory or another could be accessed [11].

Undoubtedly, the merit of VR technology use in comparison to more conventional methods is that learners are able to accurately depict and illuminate characteristics or processes that they would otherwise not be able to recognize or recount with more conventional methods. In other words, VR can help the learners experience while simultaneously observe various perspectives of an object which may not have even been considered let alone seen in the past.

3. Positive Aspects

A number of studies have been carried out concerning the utilisation and practicality of VR in both education and training. Duncan, Miller and Jiang [12] highlight that VR worlds may provide space for joint work, entertainment and socialization within an educational or learning context. Gilbert [13] claims that more often than not learners reckon science subjects to be incomprehensible and complex; therefore, they require a depth of understanding and visualization skills that can be provided through VR environments.

The issue of misconception can be tackled through the use of visualisation technologies such as virtual reality. Despite the indisputable merits of mobile and VR technologies, it is vital that we investigate the positive and negative aspects of using them in educational environments [14]. Distractions can be eliminated through the exploitation of VR which can be extremely beneficial for students with disorders such as anxiety disorder, impulse-control disorder or attention-deficit disorder while at the same time may address them by capturing their interest [15].

Moreover, virtual and augmented reality allow students to interact and learn in environments beyond their physical reach [16]. For example, students experiencing the aforementioned disorders would be able to take a virtual tour of well-known museums globally, explore the prehistoric world of dinosaurs or even carry out experiments without any fear of injury.

3.1 Use of Examples

Throughout primary and secondary education contexts, virtual reality is one of the mostly used developments. Programmes such as Google Expeditions and Google Earth allow for virtual visits of student to landmarks, museums, places of interest globally without any need for students to leave the classroom. Another example of such use of virtual technology is Mind and Anatomy 4D through which learners are given the insights to explore the brain and body organs while EON Experience provides content for teaching and learning History and Science. The use of VR can simulate events and submerge learners in the virtual world. As a result, they perceive events, points, traits and differentiations that would otherwise be difficult to comprehend and consolidate [1]. VR could act as a trigger for motivating learners that would be indifferent towards a subject and build a positive outlook in using VR in their learning process [17]. In other words, VR triggers students' involvement in the learning process since they are challenged and urged to interact, explore and manipulate objects, visualize with precision which could in no way be feasible in a conventional educational environment [18].

3.2 Elements in Learning

There appear to be three elements in learning that act

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as catalysts; motivation, clear-cut goals and sufficient practice. If fulfilled, education may become a totally intriguing and captivating experience. The teaching and learning process tends to detach from the traditional classroom and move towards utilizing a virtual environment involving computer-generated 3D models barely exploited in the past partly owing to a number of constraints such as familiarization of educators with this type of technology, cost-efficiency or even hardware limitations [19]. However, recent progress in the field of technology has resolved such problems, creating new educational opportunities that are less costly and more efficient in the long run [20].

Although it seems to be implausible to radically alter the way teaching is performed in the classroom, VR is undoubtedly going to enable teachers to enrich their learning with entertaining and enticing experiences that will make learning and consequently teaching more appealing to both counterparts. Apart from primary and secondary education, higher education institutions can benefit from using VR. Instead of having undergraduate and postgraduate students read about a topic in textbooks, they could become members of a virtual laboratory. The latter allows students to investigate a scientific phenomenon and perform learning by doing; through a kind of virtual hands-on learning. It goes without saying that being outside the classroom helps students acquire practical skills rather than just read instructions and eventually triggers emotional reactions. Through their emotional reactions, students will be able to recollect and be highly motivated to keep up with learning through their virtual reality classroom.

The collaborative learning approach supported by the computer refers to the use of computers as cognitive "artifacts" which can promote active and collaborative knowledge building. This approach focuses on the role that computers can play in student learning, from mediating face-to - face learning to providing environment for virtual learning [21]. A successful virtual learning environment can be described as an environment in which students are able to build their own knowledge, challenged to be active agents who are interdependent and perceive and experience the virtual learning environment as supporting collaborative learning [22].

3.3 Gaming Effects

On the other side of the spectrum, a number of studies emphasize on the beneficial effects of the use of games in education, especially that of interactivity [23]. In this respect, games engage students' interest and urge them to apply what they have learnt in the game context. This experiential type of learning is boosted through the use of virtual reality games that provide an elevated sense of interactivity and engagement [23]. Such technology allows three kinds of experiences; the first being experience in size. This means that virtual reality devices directly place the student in stereoscopic 3D within the environment allowing them to experience size differently than in any ordinary game [24]. This allows them to see information in their correct scaling. Secondly, transduction refers to interface devices to present information being used to present information that is difficult to perceive by the senses [24]. These include changes in the sound to indicate distance or changes in motion speed to indicate movement in different terrains. Finally, reification involves the process of representing objects or events that have no physical form into perceptible objects.

3.4 Future of Virtual Reality in Education

Unquestionably the development of technologies linked to virtual and augmented reality will be driven by the entertainment world. More efficient development and processing engines will be developed, and new interaction devices will amplify the potential use of human senses [25]. Two networks with very different characteristics are clearly identified in relation to the education sector, to concentrate on and make the most of the technologies in question. The future concerns the creation of frameworks that allow fast configuration of these environments without having to follow up with a new architecture from scratch if a new solution is to be introduced. Exploring a motor or a human body inside a theoretical description gives the consumer the ability to select and push each feature of the model at will is a very clear example. In addition to seeing the model, students will also receive all the information around each part of the model. In the field of technology, the future will be through the introduction of more senses within the experience [26].

4. Methodology – Research Part

Research in the international literature focuses on learning outcomes related to characteristics such as discomfort, user sickness, the impact of immersion on students' interest and involvement, student motivation, and the development of critical analysis [27]. The research method that will be followed is the quantitative study between subjects as it is necessary to control the results of both this application and the use of the textbook. This model is considered suitable as it provides us with flexibility in possible teaching interventions. The number of students is small (10) as the application will "run" in a

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school with a small number of students, so the result will be classified in a single case.

The steps that need to be taken to make the research successful initially include teaching the application to the students followed by the implementation of the teaching scenario on their part [28]. The main purpose of the research is to investigate the extent to which a Virtual Reality application can help students to understand and evaluate the religious elements presented to them in comparison to the textbook. Having studied several researches that have integrated 360° applications [29-31], we came across two crucial aspects the results of which will be examined at a later stage. The questions that arise are mainly how students can better understand the data presented to them through a virtual reality application using 360° video compared to the textbook as well as their impressions and attitudes regarding the use of virtual reality in the lesson of Religion.

In order to create the courses, especially designed pamphlets and additional material was opted for. The sections of the booklet were separated using titles and symbols at the beginning of each section. They were also divided into three main parts; theoretical part, activity and material for further study. Along with the leaflets, the students were given additional material [32]. The teaching model chosen is the model of constructivism which represents reality in a variety of ways leading to consolidation through social experiences leading to discovery learning, in which students develop skills or discover various ideas and principles. According to this model in the first stage of engagement, students are given the opportunity to be involved in the learning process through open - ended, be interested in the teaching unit through small activities in order to connect previous and current knowledge. In the exploration stage, students are provided with a common basis for activities in which current concepts are identified. In the explanation stage, the students' attention is focused on specific aspects of the previous two stages and provides opportunities to prove that they have understood the views they have developed so far through the implementation of activities. In the expansion phase, students explore what they have learned thoroughly and apply any new knowledge acquired to additional activities. In the evaluation stage, the students as well as the teacher evaluate the progress and the advancement of their knowledge.

5. Creating Lessons

5.1 360° Video

Among the various fully-immersed virtual reality learning environments, 360° videos are most often used as they have wide availability and low construction costs [33]. These videos are multi-directional panoramic videos that allow the user to rotate and tilt their point of view in a continuous sphere. They can be displayed on mobile devices or other devices, such as mobile devices (Google Cardboard) or on device screens exclusively for OP (Oculus Rift).

In terms of teaching approach, the topic and objectives of learning should be identified. It should be decided on what elements or aspects of teaching the use of this video is required and then which objects and scenes to be photographed or recorded should be defined. Many studies have explored their potential with different research questions such as the involvement of students, the development of their skills [34], the ability to solve complex problems [35], the cognitive load that create in students and the effects on their interests. The use of videos seems to provide opportunities for the development of teachers' abilities through virtual experiences that examine the effectiveness of their teaching methods or for the potential training of teachers [36]. Video 360-degree allows students to watch a scene in any direction they want. This helps the student experience essentially the world captured on the 360-degree video. The picture they see moves in unison on mobile devices as the students switch and turn the screen left and right or up and down. Students navigate videos through laptops and desktops by clicking and dragging onto the image, or by running their finger across the screen on screen-sensitive devices. Students can commit to this new form of storytelling by creating their own 360-degree videos. A 360-degree video creation involves a gadget with at least two lenses, one in the front and one in the reverse. The software stitches the two videos together to create a 360 degree view [37].

In educational contexts these videos can be used to teach a concept or skill by meeting specific learning objectives which are summarised as follows: experience of dealing with unexpected events, presentation of a scenario containing details that learners can consult as many times as needed, experience of a hidden treasure scenario with a certain number of hidden objects and finally the ability to explore a more interactive environment.

5.2 Teaching Religious Affairs as School Subject using 360° and CoSpaces Edu

In this section we briefly present how a religious affairs task can be combined with the use of 360° video. For the purposes of this paper, it is not advisable to provide a detailed presentation of a lesson plan other than capture its basic axes. Finally, some screenshots of the application created with the software mentioned above are presented.

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Web-based VR authoring tools such as InstaVR, WondaVR, and CoSpaces make creating original VR artefacts with little or no programming experience feasible. This study chose CoSpaces because of its simple visual, drag-and-drop interface and built-in support for use in educational settings [1]. Virtual reality systems promote situated learning through the immersive experience of interactive objects, environments and processes [38]. CoSpaces allows for the creation of virtual 3D worlds that can be explored using smartphones, tablets, and PCs with the ability to take advantage of the VR viewer" [38,39]. CoSpaces uses a visual programming editor similar to the Scratch programming environment, to specify code for modelling and animating simple virtual worlds. In primary and secondary education, students have used CoSpaces for digital storytelling, creating virtual art exhibitions [39] and recreating historical scenes [1]. Creating VR lessons accelerates learning by allowing students to apply their own subject-matter knowledge.

CoSpaces Edu[1] is a tool to create virtual tours using 360° photos. This tool was chosen as it is considered easy to use by all age groups of students. The main goal of this lesson is to urge students to do a significant amount of research and data collection, organize the information they gathered, and decide how to best present it. Moreover, the advantages involve giving students the opportunity to discover and explore destinations outside the classroom without having to go out of the school grounds, motivate them to use new technologies constructively while enhancing creativity.

In the first section, an introduction is given and the students are asked if they have ever attended a tour of a museum, sports field, city or attraction in general, and then are presented with a virtual tour created with the specific software. In the next step, students are informed about how they should 'move' during the lesson and what the final result should be. In the second phase, we divide the students into groups of two or three people depending on the equipment of the school and direct them to look for suitable 360° type images. In addition, we ask them to write down on a piece of paper the points they consider important and write a text about them. In the last stage, the students proceed under the supervision of the teacher in the construction of the virtual tour. Finally, students can visualise their projects in VR or AR mode and see them using a VR headset.

5.3 Application

The virtual reality application was based on the CoSpaces application. All material used was uploaded to this application. 360° images were added with interaction points and connection between the scenes was made. The audio files used were processed with VLC open source software vlc. Additional functions of the application required, programmed in a script language similar to scratch. Yamanda [40] states that virtual reality applications allow users to look and / or move in any direction, but some of the students may consider that this constant operation makes them tired. This does not apply to the application as its size is such that it does not tire the students. In the final stages of development, video files were converted for better playback on mobile devices, as well as configuring build-in options for better application performance on low-end devices. Finally, the files were exported so that the application could be "run" on virtual reality devices such as Oculus Rift, Oculus Go or Google Cardboard.

The application consists of three 360° videos, each depicting an Orthodox church, a Catholic church, a mosque and a Buddhist temple. Moreover, in each video there is a figure that plays the role of the guide in each temple, conveying information about each religion and the architecture of each temple. Students can also interact with specific points marked with icons that contain additional information.

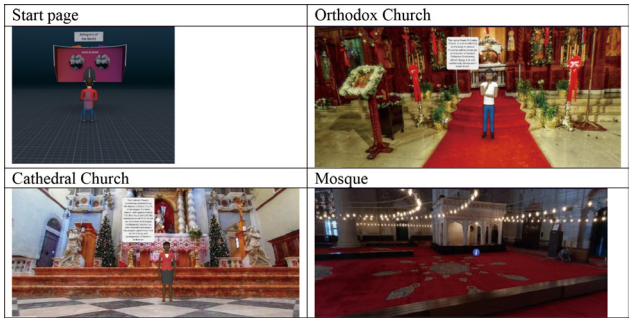

Figure 1. Application

5.4 Worksheet

Worksheets that focus on the analysis of religious - historical data are made up of forms that enable students to read and analyse documents in terms of their physical attributes and content. Studying the documents with such questions, students get the opportunity to combine their interpretation of the document with the scientific connections they've made and put it down in writing. That way we explore what students have grasped from the text and follow the mental processes they go through during the whole task of analysing it. Then, the worksheet that is to be given to the students is presented, which will be completed based on what they have been taught from the textbook but also through the information they had retrieved via the application [41].

1. https://cospaces.io/edu/

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Table 1. Worksheet

Comparing World Religions			
	Christianity	**Islam**	**Buddhism**
Profit or Founder	Who was an important missionary that spread Christianity?	Who founded the religion of Islam?	Who founded the religion of Buddism?
Monotheistic or Polytheistic	Is the religion monotheistic or polytheistic?	Is the religion monotheistic or polytheistic?	Is the religion monotheistic or polytheistic?
Population	How many people practice Christianity?	How many people practice Islam?	How many people practice Buddhism?
Location	Where was the first Christian church located?	Where did Islam begin?	Where did Buddhism begin?
Major Beliefs	What is the main Christian belief?	Summarize the Five Pillars of Islam.	What are the most important virtues of Buddhism?
Holy Text	Which is the sacred text that Christians accept?	Which book do Muslims consider sacred?	There is a book that is considered sacred?
Place of Worship	Where do Christians worship?	Where do Muslims worship?	Where do followers of Buddhism worship?

6. Conclusions - Future Plans

Taking everything into consideration, the use of virtual or augmented reality in classrooms could be a groundbreaking feature that could shift the direction of contemporary teaching and learning. We should take into account the benefits and the potential limitations of such implementation so as to plan and set the goals and objectives for the lessons. The ultimate prospect is to engage learners' interest and make them get involved in order to acquire the knowledge that they initially regarded as incomprehensible or even unattainable.

The process of creating original VR scenes will be new for most students and will provide a useful way to apply knowledge gained by researching VR applications. Creating VR also offers a new way for students to use their mobile devices. Researching panoramic camera apps, using a 360-camera connected to a smartphone over Bluetooth, designing or running the CoSpaces app with Google Cardboard, all incorporated the use of mobile devices to this project. The entire project introduced VR as a relevant current technology, and as the goal for student-created multimedia. Students will also learn how VR scenes can change how they experience virtual worlds, as well as how they apply their knowledge gained in those virtual worlds, to the real world.

The 360^{o} videos are an original teaching method that allows students to immerse themselves in virtual learning environments of authentic 3D photos and videos [42]. These videos are more immersive than traditional ones because users have the ability to look at all the points and explore different parts of the scenes. In addition to students, their use can greatly benefit teachers in evaluating their teaching methods [43] as well as training potential teachers [44]. Regarding the lesson of religion, their use enables students to attend a place of worship exactly as it is. In addition, they have the ability to better understand the various religions and their symbols in relation to simple text reading or 2D image observation. Instructors can also create digital material for the lesson using a 360^{o} camera or use an application such as Google Expeditions.

The authors' immediate plans involve implementing the educational scenario in a primary school and in the first phase to analyse the data in detail and then statistically display them.

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