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Introduction Virtual Reality for Learning Media in Schools in Indonesia

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Abstract. This paper aims to introduce Virtual Reality (VR) as a learning tool for students. As the first study (Case I), we present a VR simulation as a learning therapy tool using the VAKT method (visual, auditory, kinesthetic, tactile) for children with Autism Spectrum Conditions (ASC). The second example (Case II), VR was used as a display environment to explore biology learning for senior high school students. Finally, the result from our experiences and lessons learned, VR can be used as a tool for school learning both for regular students and ASC.

1. Introduction

Virtual Reality (VR) is a computer-simulated 3D environment. Users can observe and touch simulated objects in that environment, giving the knowledge that these objects do exist [1]. VR is part of blends of reality with virtual components. Along with this continuum related areas of reality and virtuality are augmented reality and mixed reality [2].

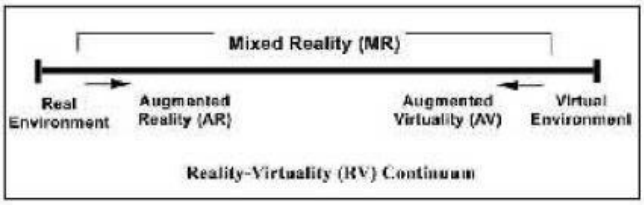

Figure 1. RV Continuum [2]

Technology of VR is not new; in the early decade of 1990's already existed. Started by Ford, he was using VR for design and production of its vehicles [3]. However, at the time, VR used in various fields: traveling, everyone would wave their hands to do visiting in other places, converse with virtual people, and experience adventures in excellently simulated environments 4]. Other than fundamentally industrial military uses VR such as combat training, 3D visualizations, Simulator technology [5-7]. The University of Washington's Human Interface Technology Lab (HITL) using V R for experimenting with students in real educational [8]. VR for entertainment, R make the film to be the great immersion of multiple senses and interactivity that is usually connected to as true VR. VR makes storytelling has extraordinary potential [9].

Today, we are approached with very different views; technology that was once too high or impossible for consumers is now available. The popularity of several major consumer products such as Google Cardboard, Daydream View, Oculus Rift, HTC Vive, Samsung Gear VR, Playstation VR, and Microsoft HoloLens is evidence that technical developments have finally solved many problems that previously

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destroyed VR. That its rapidly expanding abilities have expanded VR reach to more consumer bases [10]. Smartphones and tablets can also function as a platform for VR applications, and consequently this technology approaches on a familiar device.

There are principally three levels of Virtual Reality [11]:

1. Non-immersive. Using a desktop computer, the virtual environment is generated without any specific use of hardware or other processes. If the machine is available, almost any scenario can be simulated, which reduces any threatening dangers. This level can be used for training purposes.
2. Sensory-immersive (Semi-immersive). This process is modeling of the real environment for play in several virtual reality applications, such as robot navigation, architecture modeling, and airplane simulation. The user can operate a visual representation of him within the virtual environment. And this level gives the illusion of immersion in the virtual environment.
3. Neural-direct (Fully Immersive). The last level is the fundamental concept to succeed for VR. It represents an immersion into a world where the human brain is directly connected to a database and the viewer's current position and orientation. It ignores the equipment and the physical sense completely and projects a sensory input directly into the brain while continuously projecting the user's recognizing directly into the virtual world.

In this paper, we approach the use of VR, especially based on Google Cardboard, in education in Indonesia's school. Design of application VR and the influence of using VR for learning media by present two case studies, where VR was applied in school courses.

2. VR: Opportunities and Challenges in Education

In the following sections, we describe how examples of how VR can create new learning opportunities.

VR leads to enhanced learner engagement

Many aspects of VR give an opportunity to encourage student engagement. Such as Google Expeditions leaves teachers to transport students to virtual field trips to Mars and the bottom of the ocean [12]. The Body VR, which students have the opportunity to navigate inside the human body's bloodstream as a red blood cell [13]. The originality and entertainment value of VR can be used to draw in the attention of lost and unbiased students, including in subjects that some students may usually find boring or unnecessary. From there, VR can maximize the learning experiences and also encourages engagement by providing students with a powerful sensation of presence and immersion compared to traditional learning environments such as: reading literature in a classroom; passively watching videos; watching performance theatre. Because VR makes a subject in the learning area come alive.

VR for constructivist learning

VR also gives an opportunity for constructivist learning, such that allowing students to construct their knowledge from meaningful experiences. Furthermore, introductory astronomy courses, VR activities make the students-built 3D Solar Systems supporting higher knowledge of astronomical theories [14]. Another example, Fantastic Contraption uses constructivist theory to strengthen principles of physics, where the students can build a machine and if it does not work correctly, they use problem-solving skills until it functions perfectly [15]. VR also presents an opportunity for training, therapy, or simulation in situations where repeated exercise and safe area to fail are present. This can be used for therapy for students with disabilities, post-traumatic stress disorder, or social concern. The virtual environment allows students control over their learning in a consequence-free, without fear of serious consequences from their mistakes [16].

VR can visualize difficult models

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VR also allows students to imagine anything from their creativity and to easily visualize and manipulate objects to make difficult concepts easier to understand. Example, as follows CoSpaces that student allows coding and easy creation for demonstrating their mental models [17]. Tiltbrush by Google is a VR application that encourages creativity and artistic expression. By Tiltbrush, students can paint, sculpt, and design 3D objects and landscapes using creative – and impossible parts such as fire, snow, and stars – and share them with others. VR makes the virtual environments can represent indirectly visible and manipulable forms concepts and procedures that are intangible and invisible in the real world. Using this technology can help students to represent hard-to-visualize and complex theories.

3. Case I – A VR Simulation As A Learning Therapy Tool Using The VAKT Method For Children With ASC

Introduction

Virtual Reality using Smartphone and Google Card Board for therapy for children with ACS using VAKT (Visual, Auditory, Kinesthetic and Tactile). The objective of this application is to introduce several objects through the VAKT approach. Henceforth, it will be seen how the results of value acquisition are based on the criteria of speed and accuracy in solving problems in this application.

Figure 2. VAKT Learning with VR

Design

This application is divided into four main menus, i.e., visual, auditory, kinesthetic and tactile. Each menu can be accessed by directing gazepointer on one of the buttons and clicking the button on the cardboard. Each menu is shown in figure 3.

- Visual Menu

  Users are asked to show objects based on sound instructions that are heard. The value to be obtained for each object is 1 if the one that is chosen is correct, and vice versa if one gets the value 0.

- Auditory Menu

  The user will be represented with the sound coming out of an object; then the user is asked to show the object in question. The value for each object is 1 if one is selected correctly, and vice versa if one gets a value of 0.

- Kinesthetic menu

  Introduce how to write letters based on sound instructions and image patterns provided on objects. Users are asked to direct the gazepointer based on the patterns presented to form letters. If the pattern designated is by the letter pattern requested, it gets a value of 1; if it does not match the pattern, then the value is 0.

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- Tactile menu

  Users are asked to complete compiling the puzzle into a complete picture by pointing the gazepointer by clicking on the object on the right and clicking on the object on the left to match the laying of the image. To facilitate the user in compiling the puzzle, equipped with sound instructions and the correct example of the image, by clicking on the object on the right and clicking the object on the left to match the laying of the image. Each object has a value of 1 if it is correctly arranged and if the value is incorrect 0.

Figure 3. Menu Visual – Menu Auditory – Menu Tactile – Menu Kinestetic in VAKT Learning with VR

Evaluation
A series of the evaluation was conducted involving 10 children with different ACS levels to test the efficacy of the VAKT. The results show there was only 1 child from 10 children; there is a significant increase in value. This explicates that effectiveness of VAKT Learning with VR but it does not apply to all ACS children.

4. Case II - VR Was Used As Biology Learning For Senior High School Students

Introduction
Anatomical applications of the virtual reality of the human body are made as learning media in conveying biological material about kidney organs. In this application, it presents kidney parts and their functions, mechanisms of urine formation and kidney disorders.

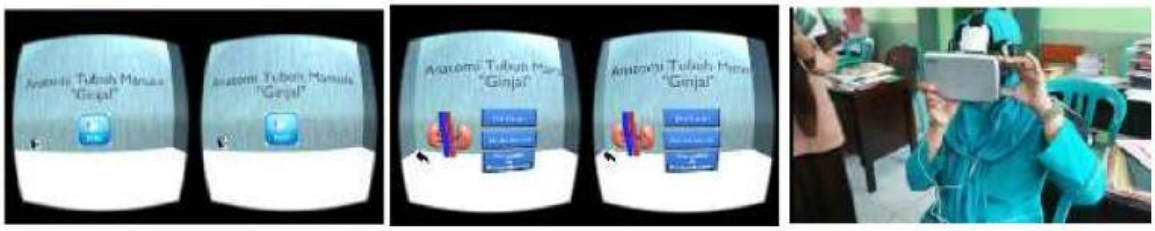

Figure 4. Kidney Anatomy VR

Desain
This kidney anatomy virtual reality application consists of a menu of definitions, mechanisms, diseases and their treatment. The definition menu will access the kidney definition scene and detail of kidney anatomy. On the mechanism menu, there is a puzzle as a game to understand kidney anatomy and function.

Before that, it will be presented with the animation of the urine formation process. The disease and treatment menu are a menu of kidney stones and kidney failure.

- Definion Menu

  In the definition, the menu explains the definition of the kidney in the form of a picture along with a background. In this menu, there are two button options, namely the detail button to proceed to the kidney display menu in detail and the back button to return to the previous menu. If you select the

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detail button, you will go to the kidney detail display menu in Figure 5b which displays the kidney in detail. In detail, the kidneys can find out the name of each organ and zoom in on one of the kidney details.

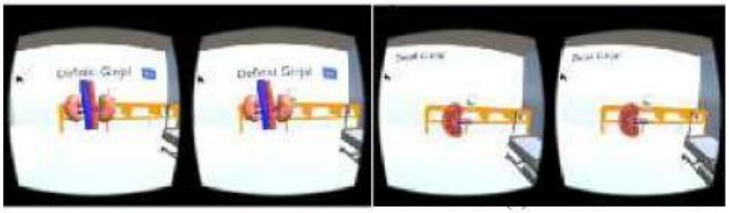

Figure 5. (a) Display of kidney definitions (b) Display of kidney detail

- Mechanism menu

This menu displays the process of forming urine which demonstrates nephrons as the central organ of urine formation with an explanation in the form of animation of urine formation as seen in figure 6. If the gazepointer is directed at parts of the organ, there will be an explanation of the process of urine formation. In this menu, there are two selection buttons, namely the puzzle to enter the puzzle menu and the back button to return to the main menu.

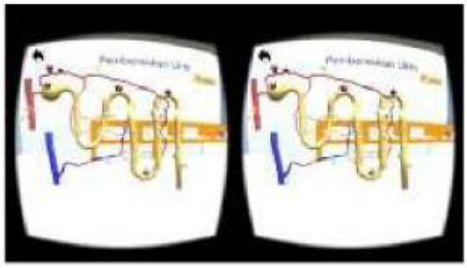

Figure 6. Display of urine formation

In figure 7, the puzzle menu is showing random kidney organs; the user is asked to arrange the kidney organ correctly by clicking on the organ then clicking on the area provided, the pieces of the organ will move to the right place.

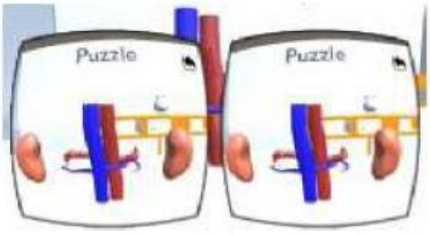

Figure 7. Display puzzle

This menu will display a kidney disease menu that has three selection buttons as shown in figure 8. The first button is on the vein to display kidney stone disease along with its treatment, the second button is on the kidney to display kidney failure and its treatment, and the last button is back to return to the main menu.

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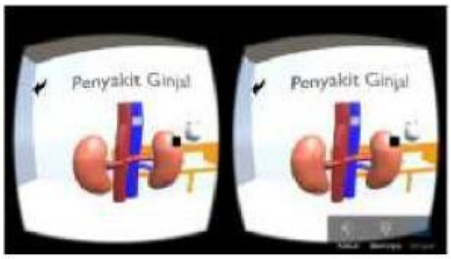
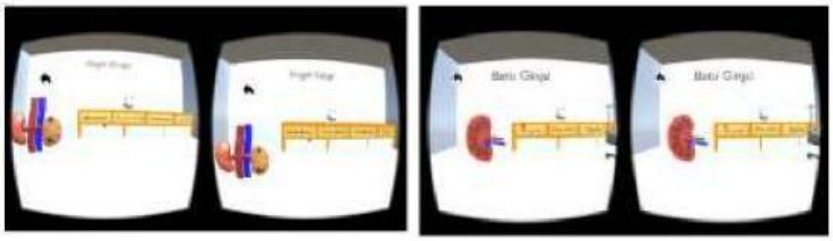


Figure 8. Display of kidney disease

In Figure 9, the kidney failure menu displays the kidney part that has kidney failure. In this menu there are treatment options that can be done, namely drugs, dialysis, transplantation, and lifestyle changes, if one of the treatments is selected it will display each explanation of each treatment.



(a) (b)

Figure 9. (a) Display of kidney failure (b) Display of kidney stones

Evaluation

In this study, the respondents were student of senior high school in class XI. In table 1 describes the testing using the MGBL (Mobile Game-Based Learning) indicator with an average of 74%.

Table 1. Percentage of MGBL Indicator

Indicator MGBL	**Percentage %**
Learning Content	64%
Knowledge	60%
Display of User Interface	84%
Application Control	86%
Average	74%

5. Conclusion

In this paper, we have presented two case studies, where virtual reallity technologies have been integrated into school course using smartphone and Google Cardboard. By looking at the results of the two case studies presented in this paper, VR applications can be used as learning media for regular students and students with ACS. As all our participants were first time VR users, therefore a detailed explanation is needed about the use of this media so students can use it well, especially for students with ACS. The explanation is done repeatedly by experimenting several times with each student.

The two case studies are about integrating VR technologies as part of the courses in their school. Interest for stimulating experiences seen from the results of the experiments presented from each case. However, more research is needed, especially for students with ACS.

Finally, we note the limited features of supporting VR applications, as a learning media in education. Completely, there is still much to improve in creating easy and flexible tools for VR in design education.

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We can conclude that VR technologies using a smartphone and Google Cardboard can already be successful in Indonesia's school, where they offer interesting and useful possibilities.

6. References

[1] P. Halarnkar, S. Shah , H. Shah , H. Shah4 , A.Shah, "A Review On Virtual Reality", IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 6, No 1, November 2012 ISSN (Online): 1694-0814 www.IJCSI.org.

[2] P. Milgram, H. Takemura, A. Utsumi, F. Kishino, "Augmented Reality: A Class Of Displays On The Reality-Virtuality Continuum", Telemanipulator and Telepresence Technologies (1994) – SPIE Vol. 2351, 282-292

[3] J. Gaudiosi, "How Ford Goes Further With Virtual Reality", 2015. Available from: http://fortune.com/2015/09/23/ford-virtual-reality/

[4] F. Steinicke, "Being Really Virtual: Immersive Natives and the Future of Virtual Reality", Springer, Switzerland, 2016

[5] C. Cruz-Niera, "Beyond Fun And Games: VR As A Tool Of The Trade", Session Presented at the Virtual Reality Summit, 12 April 2016, New York

[6] A. Pollack, "For Artificial Reality, Wear A Computer" New York Times, 10 April 1989, Retrieved from http.//www.nytimes.com/1989/04/10/business/for-artificial-reality-wear-a-computer.html?pagewanted=all.

[7] A. Lele, "Virtual Reality And Its Military Utility", Journal of Ambient Intelligence and Humanized Computing. 4. 10.1007/s12652-011-0052-4, 2011

[8] P. Moore, "Learning And Teaching In Virtual Worlds: Implications Of Virtual Reality For Education", Australian Journal of Educational Technology, 1995, 11(2)

[9] https://www.mesalliance.org/2017/02/15/me-journal-bringing-vr-to-hollywood/

[10] E. Hu-Au, J. Lee, "Virtual Reality In Education: A Tool For Learning In The Experience Age", International Journal of Innovation in Education. 4. 10.1504/IJIIE.2017.10012691, 2018

[11] K. W. M. Wills, "What Are the Different Types of Virtual Reality Technology?," wiseGEEK. [Online]. Available: http://www.wisegeek.com/whatare-the-different-types-of-virtual-realitytechnology.htm.

[12] B. Ferriter, "Tool Review: #GoogleExped.s. Virtual Reality App, The Tempered Radical", 9 March 2016, Retrieved from http.//blog.williamferriter.com/2016/03/09/tool-review-googleexped.s-virtual-reality-app/

[13] [13] https://thebodyvr.com/

[14] M. Barnett, L.Yamagata-Lynch, T. Keating, S.A. Barab,. and K.E. Hay, "Using Virtual Reality Computer Models To Support Student Understanding Of Astronomical Concepts", The Journal of Computers in Mathematics and Science Teaching, 2005, Vol. 24, No. 4, pp.333–356

[15] C.G. Porter, "Hands-on: Creating Magical Machines with 'Fantastic Contraption' on HTC Vive, Road to VR" Retrieved from http.//www.roadtovr.com/fantastic-contraptionhtc-vive-hands-on-pax-prime-2015

[16] Virtual Speech Ltd. 2016, Retrieved from http.//virtualspeech.com/

[17] W. Winn, H. Hoffman, A. Hollander, K. Osberg, H. Rose, and P. Char, "The Effect Of Student Construction Of Virtual Environments On The Performance Of High-And Low-Ability Students", Presented at the Annual Meeting of the American Educational Research Association ResearchGate, Chicago, IL. 1997

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