The Effectiveness of Virtual Reality Comic Picture to Enhance Individual Learning Outcomes

Rini Riris Setyowati(✉), Saefur Rochmat, and Aman

Universitas Negeri Yogyakarta, Yogyakarta, Indonesia
riniriris456@gmail.com

Abstract. This study aims to determine the effect of learning media using virtual reality technology on comic images on student history learning outcomes. The focus of this research on the development of learning media is to test and compare the differences in student learning outcomes on the material for the proclamation of independence. The data collection method used is experimental and class control involving 113 students. The analysis used in processing the data is Analysis of Variance. The results showed that student learning outcomes were higher when using virtual reality learning media than textual instructional media. This study shows that virtual reality learning media has a significant impact on improving student learning outcomes. The experimental class that uses virtual reality media is more active in learning. This condition confirms that the virtual reality comic picture media with historical material has proven effective for use as learning instructional media in the classroom.

Keywords: Comic Picture · Individual Learning Outcome · Virtual Reality

1 Introduction

Generation Z pupils can quickly adapt to increasingly sophisticated technology, but the development and variety of learning media in technology-based history lessons remain limited [1]. The positive impact of massive technological developments can be utilized to support the development of the world of education. Technology and social media have significantly impacted how young people learn history in and outside of school [2–4]. One of the potential benefits of using technology in learning history is to develop students' historical thinking and understanding under the development of the modern era [5]. The teacher is vital in composing the suitable learning composition, from the material to the media support [6]. The teacher's role in delivering effective learning requires technological support appropriate to students' needs. Research and development (R & D) on technology-based learning media can add variety and a source of alternative learning media in education [7–12].

Some research in historical learning shows the use of technology-based media as media to support learning, such as video games [13], animation [14], comics [15], and social media [16]. Based on the latest developments, virtual reality has also begun to be

M. Kristiawan et al. (Eds.): OCERI 2023, ASSEHR 775, pp. 562–571, 2024.
https://doi.org/10.2991/978-2-38476-108-1_54

applied as a learning medium in the classroom [17, 18]. Research and development of technology-based learning media have been widely carried out. However, research on the use of audio and visual media is still limited, especially in the use of virtual reality. Virtual reality technology in classroom learning encouraged students to understand the material comprehensively [19]. Thus, the effectiveness and efficiency of virtual reality learning media can be tested by the ability of students to understand the material based on student learning outcomes.

Effective learning does not only rely on support from learning media but all components involved in the learning process. So far, there has not been much research and development of learning media that specifically discusses the use of media with virtual reality technology in history learning. Virtual reality technology can allow individuals to use technology more interactively in learning [20]. More fundamentally, the negative stigma increasingly attached to learning history without the use of up-to-date media continues to grow [1, 21, 22]. This research focuses on the development of learning media in presenting technology-based historical material so that it is easily understood by students comprehensively and under technological developments.

This research on learning media development based on virtual reality technology contains material on Indonesian history about the events of the Indonesian Independence Day Proclamation. This material is an essential part of the history of the Indonesian nation, so its presentation must be able to attract the attention of students to study history. This research combines media and technology, namely comics that are packaged in virtual reality technology. Collaborative learning media can fill each medium's weaknesses and shortcomings referred to as transmedia storytelling [23]. Transmedia storytelling in the form of images in virtual reality technology can provide a more immersive environment [24, 25]. Technological support for students in learning can support constructivist and chronological learning concepts in historical material. The environment, which is as close to being in an open space as is possible with the technology available to the students, can make learning more active, interactive, collaborative, and participatory.

2 Literature Review

1) **Virtual Reality**

Virtual reality (VR) is one of the most advanced media to present and explore the details of the real world in cyberspace [20, 26]. VR research and development involves various disciplines such as computers, communications, graphic design, and social science as a liaison between technology and users [27]. VR technology has limitations in presenting space, time, and events. VR users can experience an atmosphere similar to the current real-world situation [28]. One of the advantages of VR technology that other media technologies do not have is the ability to build an immersive environment [29, 30]. The curiosity of users of VR technology is claimed to be increasing, which can positively impact memory [31].

2) **Comic Picture**

Comics are one of the media that have been used to communicate information through narration and are equipped with pictures [32]. The storytelling method using comics

has a sequence of plots. Comic image media makes it easier for readers to remember the information conveyed [33]. Comic images can pack light information that is both interesting and entertaining [34]. Thus, drawing comics is unique, making readers more focused on observing pictures and reading stories [25, 35]. Comic is often used to describe superhero characters, wars, and historical stories [36].

3) **Individual Leaning Outcome**

Individual learning outcomes are related to students' cognition, affect, and behaviour abilities [37]. One of the determinants of student learning outcomes is the communication and interaction that exists in the classroom between teachers and students [38]. This communication and interaction need to be supported by learning designs and learning media that follow the needs of students. Student learning styles also play an essential role in indicators of individual learning success [39]. Individual learning outcomes require diagnosing the individual's ability to receive learning materials [40]. Differences in student learning styles and their impact on learning outcomes challenge teachers to provide learning support that is acceptable to all students.

3 Methods

The method used in this research is called a quasi-experiment. The implementation is performed in two classes in Budi Utama Yogyakarta High School. The sample was collected using a random sampling calculation of 113 students. The given instrument is a multi-choice question consisting of 25 valid and reliable questions to measure the students' cognitive learning outcomes at Budi Utama Senior High School. The transformation of students' learning outcomes is calculated using the N-Gain test to measure the difference between pretest and post-test scores [41]. The ultimate score may be determined by comparing the maximum score (Smax) from the pretest and posttest to the Spretest (early score) and Sposttest (final score) [42]. While the t-test still is used to answer the hypotheses [43]. The levels of the N-Gain are classified into three categories as shown in Table 1 [44].

The research observation step is used to find the correlation between the implementation of the virtual reality comic picture in the learning session to explore student learning outcomes. The observation result of implementing the student's activity in the class learning session is calculated with the formula [45].

$$\text{Percentage } (\%) = \frac{f}{N} \times 100\%$$

Table 1. The Criteria of N-Gain Test

Category	Criteria
$g > 0.70$	High
$0.30 \leq g \leq 0.70$	Moderate
$g < 0.30$	Low

Table 2. The Criteria of Observation

Range Score	Criteria
$80\% < p \leq 100\%$	Excellent
$60\% < p \leq 80\%$	High
$40\% < p \leq 60\%$	Fair
$20\% < p \leq 40\%$	Low
$0\% \leq p \leq 20\%$	Poor

Information:

f = The total of the students' score
N = Students' total

The observation result is described using an observation percentage criteria as given in Table 2 [46], (2015).

4 Results and Discussion

There were 113 students who participated in the study using virtual reality comic pictures as learning media. The display of the results of the development of Indonesian history during the proclamation of learning media in virtual reality comic picture learning media is focused on the events of Indonesian Independence Proclamation Day. The following is a panoramic 360-degree comic picture format that can be displayed using virtual reality technology.

The student's learning outcomes can be seen from the pretest and posttest scores that can later be used to compare before and after using virtual reality comic pictures as learning media. According to the research using the control and experiment classes, the data normality test can be collected, as shown in Table 3.

Table 3 displays that the average score on the experiment class's pre-test questionnaire is 97.58, with a significant rate of $0.135 > 0.05$. The study results are normally distributed according to the SPSS version 26 computation. The normal distribution was determined for the control group with an average of 101.20 and a significant rate of $102.30 > 0.05$. The normality test result of the post-test questionnaire reveals that the average score of students' learning outcomes in the experiment class is 0.135%. In the

Table 3. The Normality Test of Learning Outcome in the Experimental Class and Control Class

Class	Result		Significancy	
	Pretest	Post-Test	Pretest	Post-Test
Eksperiment	97.58	113.30	0.135	0.155
Control	101.20	102.30	0.110	0.137

control class, it is 0.105%, with significance rates of 0.155 and 0.137 > 0.05, which are interpreted as normally distributed.

The data, which is often dispersed, is next examined for homogeneity, as shown in Table 4. Table 4's homogeneity test reveals that the significance rate with a margin of error of 0.05 is 0.38. This result indicates that the data is considered homogenous if the sig rate is greater than 0.05. Table 5 shows that the normality test and the homogeneity test are done before the t-test.

The homogeneity test in Table 4 shows that the significance rate with a 0.05 margin of error is 0.38. This result can be interpreted to mean that if the sig rate is >0.05, the data is considered homogeneous. The normality and homogeneity tests are pre-tests before conducting the t-test, as shown in Table 5.

The result of the t-test in Table 5 can be a conclusion that H_0 is rejected. The significance rate from the test is 0.000, which is smaller than 0.05. It can be interpreted that there is a difference in the learning outcomes between the students of the control and experiment classes. It can be concluded that the virtual reality comic picture about the Indonesian Independence Proclamation Day can affect the student's learning outcomes. The writer can deliver another interpretation using the $t_{hit} > t_{tab}$ coefficient criteria for assessment. The result comes from the comparison of $t_{hit} = 3.762 > t_{tab} = 2.009$ with the significance rate of 5%. Therefore, the virtual reality comic picture of Indonesian Independence Proclamation Day is better than using a textbook. The N-gain analysis is shown in Table 6 and Fig. 1 to find out the increment rate of the effectivity.

The N-gain score of the experimental class is $0.6 \leq 0.70$, which belongs to the average category. In contrast, the N-gain of the control class is $0.2 \leq 0.3$, which belongs to a lower category. The result of the N-gain shows a significant difference in the virtual

Table 4. The Homogeneity Post-Test of Learning Outcome in the Experimental Class and Control Class

Result	Significancy
Homogeneity	0.388

Table 5. The t-test of Learning Outcome in the Experiment Class and Control Class

Result	Significancy
Independent Sample Test	0.000

Table 6. N-Gain Test of Learning Outcome in the Experimental Class and Control Class

Class	N-Gain	Criteria
Experimental	0.6	Moderate
Control	0.2	Low

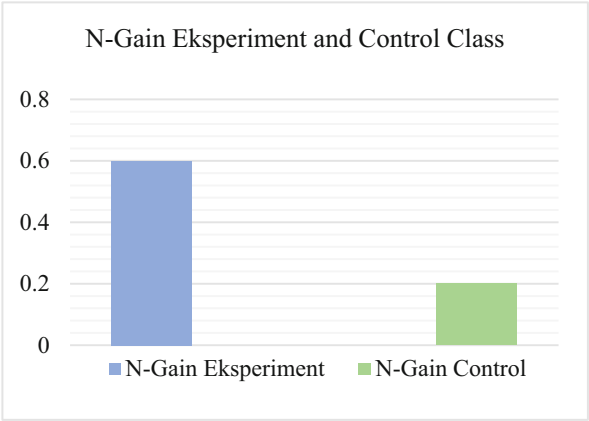

Fig. 1. The Percentage of N-Gain in Experiment and Control Class

Table 7. Percentage of Implementation Virtual Reality Comic Picture

Meetings	Percentage	Criteria
Experiment 1	86,98	High
Experiment 2	87,50	High

reality comic picture utilization between the experimental and the control class. The students in the experimental class who use the virtual reality comic picture experience a significant improvement in their learning outcomes compared to those who do not use the same equipment in the control class.

The outcome of the observation sheet is utilized to decide the implementation of an Indonesian Independence Proclamation Day virtual reality comic. According to the author's implementation findings, there is a consistent improvement with each session. The condition indicates that the virtual reality comic image implementation was successful, resulting in a slight increase in student learning results. Table 7 displays the outcome of examining the writer's observation about the desire for media among students.

5 Conclusion

The research findings show that using virtual reality technology to package historical content may aid in presenting events that are not constrained by place or time. Based on the virtual reality comic picture field test findings, which students deemed beneficial as an alternate learning medium in the classroom, the virtual reality comic picture media will be implemented. Visual reality media, including humorous visuals of Indonesian Independence Proclamation Day content, emphasize the immersive aspect of virtual reality that is comparable to the event's ambience. Comparing the usage of virtual reality comic picture media to the textual delivery of the same historical content reveals

drastically different outcomes. In the learning process, the employment of virtual reality comic visual media has a good effect on student comprehension of the topic.

Acknowledgments. Through its Project for Doctoral Degree Research 2022, the Indonesian Ministry of Education, Culture, Research, and Technology has contributed both financial assistance and partial support toward the publication of this study. The authors would like to extend their gratitude to everyone who assisted in the completion of this research.

References

1. A. E. Chapman and T. Haydn, "History education in changing and challenging times," *Hist. Educ. Res. J.*, vol. 17, no. 1, pp. 0–3, 2020, doi: https://doi.org/10.18546/herj.17.1.01.
2. T. Haydn and K. Ribbens, "Social Media, New Technologies and History Education," in *Palgrave Handbook of Research in Historical Culture and Education*, 2017, pp. 735–753.
3. M. Kainulainen, M. Puurtinen, and C. A. Chinn, "Historians and conceptual change in history itself: The domain as a unit of analysis," *Int. J. Educ. Res.*, vol. 98, no. June 2018, pp. 245–256, 2019, doi: https://doi.org/10.1016/j.ijer.2019.09.001.
4. R. Tallavaara and M. Rautiainen, "What is important in history teaching? Student class teachers' conceptions," *Hist. Educ. Res. J.*, vol. 17, no. 2, 2020, doi: https://doi.org/10.14324/herj.17.2.07.
5. G. Boadu, D. Donnelly, and H. Sharp, "History teachers' pedagogical reasoning and the dynamics of classroom implementation in Ghana," *Hist. Educ. Res. J.*, vol. 17, no. 2, 2020, doi: https://doi.org/10.14324/herj.17.2.04.
6. G. Gavaldon and O. McGarr, "Exploring pre-service teachers' future intentions to use technology through the use of comics," *Teach. Teach. Educ.*, vol. 83, pp. 99–109, 2019, doi: https://doi.org/10.1016/j.tate.2019.04.004.
7. J. M. Apostolou, B., Dorminey, J. W., & Hassell, "Accounting education literature review (2019)," *J. Account. Educ.*, vol. 35, pp. 2--55, 2020, doi: Accounting education literature review (2019). Journal of Accounting Education, 35, 20–55. https://doi.org/10.1016/j.jaccedu.2020.100670.
8. F. Macgilchrist, J. Potter, and B. Williamson, "Shifting scales of research on learning, media and technology," *Learn. Media Technol.*, vol. 46, no. 4, pp. 369–376, 2021, doi: https://doi.org/10.1080/17439884.2021.1994418.
9. J. Strycker, "K-12 art teacher technology use and preparation," *Heliyon*, vol. 6, no. 7, p. e04358, 2020, doi: https://doi.org/10.1016/j.heliyon.2020.e04358.
10. A. Burn, "Making machinima: animation, games, and multimodal participation in the media arts," *Learn. Media Technol.*, vol. 41, no. 2, pp. 310–329, 2016, doi: https://doi.org/10.1080/17439884.2015.1107096.
11. E. Hu-Au and S. Okita, "Exploring Differences in Student Learning and Behavior Between Real-life and Virtual Reality Chemistry Laboratories," *J. Sci. Educ. Technol.*, vol. 30, no. 6, pp. 862–876, 2021, doi: https://doi.org/10.1007/s10956-021-09925-0.
12. A. M. Nortvig, A. K. Petersen, H. Helsinghof, and B. Brænder, "Digital expansions of physical learning spaces in practice-based subjects - blended learning in Art and Craft & Design in teacher education," *Comput. Educ.*, vol. 159, no. July, p. 104020, 2020, doi: https://doi.org/10.1016/j.compedu.2020.104020.

13. F. B. Rahimi, B. Kim, R. M. Levy, and J. E. Boyd, "A Game Design Plot: Exploring the Educational Potential of History-Based Video Games," *IEEE Trans. Games*, vol. 12, no. 3, pp. 312–322, 2020, doi: https://doi.org/10.1109/TG.2019.2954880.
14. M. Ross, "Technological affordances versus narrative delivery?: the practice of recent virtual reality storytelling," *Media Pract. Educ.*, pp. 1–14, 2022, doi: https://doi.org/10.1080/25741136.2022.2070825.
15. C. Kraenzle, "Spirou's transnational travels: historical memory and comics memory in Flix's Spirou in Berlin," *J. Graph. Nov. Comics*, vol. 11, no. 1, pp. 117–133, 2020, doi: https://doi.org/10.1080/21504857.2019.1700144.
16. S. Yoon and D. Zhang, "Social media, information presentation, consumer involvement, and cross-border adoption of pop culture products," *Electron. Commer. Res. Appl.*, vol. 27, pp. 129–138, 2018, doi: https://doi.org/10.1016/j.elerap.2017.12.005.
17. R. C. Sari, S. Warsono, D. Ratmono, Z. Zuhrohtun, and H. D. Hermawan, "The effectiveness of teaching virtual reality-based business ethics: is it really suitable for all learning styles?," *Interact. Technol. Smart Educ.*, 2021, doi: https://doi.org/10.1108/ITSE-05-2021-0084.
18. J. Häkkilä, A. Colley, J. Väyrynen, and A.-J. Yliharju, "Introducing Virtual Reality Technologies to Design Education," *Int. J. media, Technol. lifelong Learn. Semin.*, vol. 14, no. 1, pp. 1–12, 2018.
19. X. Li, Y. Shan, W. Chen, Y. Wu, P. Hansen, and S. Perrault, "Predicting user visual attention in virtual reality with a deep learning model," *Virtual Real.*, vol. 25, no. 4, pp. 1123–1136, 2021, doi: https://doi.org/10.1007/s10055-021-00512-7.
20. C. J. Roberson and L. R. Baker, "Designing and Implementing the Use of VR in Graduate Social Work Education for Clinical Practice," *J. Technol. Hum. Serv.*, vol. 39, no. 3, pp. 260–274, 2021, doi: https://doi.org/10.1080/15228835.2021.1915926.
21. R. E. Bawack and J. R. Kala Kamdjoug, "The role of digital information use on student performance and collaboration in marginal universities," *Int. J. Inf. Manage.*, vol. 54, no. June, p. 102179, 2020, doi: https://doi.org/10.1016/j.ijinfomgt.2020.102179.
22. Susan E. Kritley., Peter E. C., *With Great Power Comes Great Pedagogy: Teaching, Learning, an Comics.* United States of America: University Press of Mississippi, 2020.
23. O. Dudacek, "Transmedia Storytelling in Education," *Procedia - Soc. Behav. Sci.*, vol. 197, no. February, pp. 694–696, 2015, doi: https://doi.org/10.1016/j.sbspro.2015.07.062.
24. K. A. Mills and A. Brown, "Immersive virtual reality (VR) for digital media making: transmediation is key," *Learn. Media Technol.*, vol. 0, no. 0, pp. 1–22, 2021, doi: https://doi.org/10.1080/17439884.2021.1952428.
25. E. Djonov, C. I. Tseng, and F. V. Lim, "Children's experiences with a transmedia narrative: Insights for promoting critical multimodal literacy in the digital age," *Discourse, Context Media*, vol. 43, p. 100493, 2021, doi: https://doi.org/10.1016/j.dcm.2021.100493.
26. W. S. Alhalabi, "Virtual reality systems enhance students' achievements in engineering education," *Behav. Inf. Technol.*, vol. 35, no. 11, pp. 919–925, 2016, doi: https://doi.org/10.1080/0144929X.2016.1212931.
27. V. Metsis, G. Lawrence, M. Trahan, K. S. Smith, D. Tamir, and K. Selber, "360 Video: A prototyping process for developing virtual reality interventions," *J. Technol. Hum. Serv.*, vol. 37, no. 1, pp. 32–50, 2019, doi: https://doi.org/10.1080/15228835.2019.1604291.
28. T. Venverloo *et al.*, "Evaluating the Human Experience of Autonomous Boats with Immersive Virtual Reality," *J. Urban Technol.*, vol. 28, no. 3–4, pp. 141–154, 2021, doi: https://doi.org/10.1080/10630732.2020.1802214.
29. I. Wohlgenannt, A. Simons, and S. Stieglitz, "Virtual Reality," *Bus. Inf. Syst. Eng.*, vol. 62, no. 5, pp. 455–461, 2020, doi: https://doi.org/10.1007/s12599-020-00658-9.
30. A. Paszkiewicz, M. Salach, P. Dymora, M. Bolanowski, G. Budzik, and P. Kubiak, "Methodology of implementing virtual reality in education for industry 4.0," *Sustain.*, vol. 13, no. 9, pp. 1–26, 2021, doi: https://doi.org/10.3390/su13095049.

31. N. S. Schutte, "The Impact of Virtual Reality on Curiosity and Other Positive Characteristics," *Int. J. Hum. Comput. Interact.*, vol. 36, no. 7, pp. 661–668, 2020, doi: https://doi.org/10.1080/10447318.2019.1676520.
32. M. McKeague, "Comedy comes in threes: developing a conceptual framework for the comic triple humour technique," *Comed. Stud.*, vol. 12, no. 2, pp. 174–185, 2021, doi: https://doi.org/10.1080/2040610X.2021.1951105.
33. J. Lamminpää, V. M. Vesterinen, and K. Puutio, "Draw-A-Science-Comic: exploring children's conceptions by drawing a comic about science," *Res. Sci. Technol. Educ.*, vol. 00, no. 00, pp. 1–22, 2020, doi: https://doi.org/10.1080/02635143.2020.1839405.
34. S. Beale, "Funny and disturbing: women's serio-comic performances on the Victorian music hall," *Comed. Stud.*, vol. 13, no. 2, pp. 186–198, 2022, doi: https://doi.org/10.1080/2040610X.2022.2091734.
35. D. Morton, "The unfortunates: Towards a history and definition of the motion comic," *J. Graph. Nov. Comics*, vol. 6, no. 4, pp. 347–366, 2015, doi: https://doi.org/10.1080/21504857.2015.1039142.
36. J. B. and T. Packer, "Heroes in the Classroom: Comic Books in Art Education," *Jstor*, vol. 54, no. 6, pp. 12–18, 2018.
37. G. M. Økland, "Determinants of Learning Outcome for Students at High School in Norway: A Constructivist Approach," *Scand. J. Educ. Res.*, vol. 56, no. 2, pp. 119–138, 2012, doi: https://doi.org/10.1080/00313831.2011.568622.
38. D. S. Kvam, J. R. Considine, and T. Palmeri, "Defining Diversity: an analysis of student stakeholders' perceptions of a diversity-focused learning outcome," *Commun. Educ.*, vol. 67, no. 3, pp. 287–307, 2018, doi: https://doi.org/10.1080/03634523.2018.1465189.
39. Li, Jessica. et.,al., "Exploring the relationship between students' learning styles and learning outcome in engineering laboratory education," *J. Furth. High. Educ.*, vol. 43, no. 8, pp. 1064–1078, 2019, doi: https://doi.org/10.1080/0309877X.2018.1449818.
40. I. Jung and J. Lee, "Open thinking as a learning outcome of open education: scale development and validation," *Distance Educ.*, vol. 43, no. 1, pp. 119–138, 2022, doi: https://doi.org/10.1080/01587919.2021.2020620.
41. Rahmawati, I, "Mastery of Natural Science Concepts for Junior High School Students on Pressure in Liquids and Its Applications," *J. Pendidik. Sains*, vol. 4, no. 3, pp. 102–112, 2016.
42. Sundayana, R, *Educational Research Statistics*. Bandung: Alfabeta, 2014.
43. Sugiyono, *Educational Research Methods: Quantitative, Qualitative, and R & D Approaches)*. Bandung: Alfabeta, 2018.
44. La Nani, Karman, Kusumah, Yaya, "The Effectiveness Ofict-Assisted Project- Based Learning in Enhancing," *Int. J. Educ. Res.*, vol. 3, no. 8, pp. 187–196, 2015.
45. Cholisin, Hikmah, "Citizenship Education Learning as a Process of Transforming Nationalism Among Students (Descriptive Study at SMA IT Abu Bakar Yogyakarta)," *J. Pendidik. Kewaraganegaraan dan Huk.*, vol. 6, no. 4, pp. 442–454, 2017, [Online]. Available: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKEwjwlPjf1NHjAhUBOSsKHZyPDxAQFjAAegQIAhAC&url=http%3A%2F%2Fjournal.student.uny.ac.id%2Fojs%2Findex.php%2Fcivics%2Farticle%2Fdownload%2F10315%2F9876&usg=AOvVaw0JqVQ9yHxXr-Ecu4wNqMdm.
46. T. A. Arigiyati, "Implementation of Authentic Assessment to Improve Student Learning Outcomes," *J. Pendidik. Progresif*, vol. 5, no. 1, pp. 129–142, 2015.