Tersedia Online:
http://journal2.um.ac.id/index.php/jrpf/
ISSN: 2548-7183

JRPF
(Jurnal Riset Pendidikan Fisika)

Development of Video Tutorials for Solving Problems on Temperature and Heat Topic to Enhance Students' Cognitive Skills

Received
03 January 2021

Revised
28 May 2022

Accepted for Publication
06 June 2022

Published
18 June 2022

Rinda Harjuna[1*], Agus Suyudi[2], Sulur[3], Endang Sriwati[4]

[1,2,3]Fisika, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Negeri Malang, Jl. Semarang 5, Malang, 65145, Indonesia.
[4]SMA Negeri 9 Malang, Jl. Puncak Borobudur 1, Malang, 65142, Indonesia.

***E-mail:** rinda.harjuna.1703216@students.um.ac.id

Abstract
The recent transformation into online learning has reduced students' cognitive abilities, as indicated by their difficulty in solving problems, including physics questions. Teachers tend to give assignments to work on questions without examples to solve those problems. Based on interview questionnaires, students have difficulty working on physics questions. The purpose of this research is to develop a video tutorial product to solve question items and to find out the products' feasibility and readability from the students' perspective. This study used Research and Development with a 4D research design. The video tutorial product was then validated by expert lecturers and resulted in an average score of 3.79 (valid). After being declared valid, then a trial was carried out on class XI students of the 2020/2021 academic year to determine the feasibility and readability of the product. The results of the limited trial showed a feasibility value of 85.0% and the readability value of 90.76%. Since the obtained feasibility and readability scores were above 80%, so the video tutorial product is categorized as successful and can be used as a learning companion media.
Keywords: Video Tutorial, Cognitive Ability, Problem Solving

Abstrak
Perubahan pembelajaran secara daring membuat kemampuan kognitif peserta didik mengalami penurunan, yang ditunjukkan oleh kesulitan dalam memecahkan permasalahan salah satunya yaitu soal-soal fisika. Guru cenderung memberikan tugas untuk mengerjakan soal-soal, tetapi tanpa disertai contoh untuk menyelesaikan soal. Berdasarkan angket wawancara, peserta didik mengalami kesulitan mengerjakan soal-soal fisika. Tujuan penelitian ini yaitu untuk mengembangkan produk video tutorial penyelesaian soal dan mengetahui kelayakan dan keterbacaan produk oleh peserta didik. Metode yang digunakan adalah Penelitian dan Pengembangan dengan desain penelitian 4D. Produk video tutorial kemudian dilakukan uji validasi oleh dosen ahli dan menghasilkan nilai rata-rata 3,79 (valid). Setelah dinyatakan valid, kemudian dilakukan uji coba kepada peserta didik kelas XI tahun ajaran 2020/2021 untuk mengetahui kelayakan dan keterbacaan produk. Hasil yang diperoleh dari uji coba terbatas yaitu nilai kelayakan sebesar 85,0% dan nilai keterbacaan sebesar 90,76%. Hasil uji kelayakan dan keterbacaan yang diperoleh mendapt hasil di atas 80%, maka produk video tutorial sudah dapat dikatakan berhasil dan dapat digunakan sebagai media pendamping belajar.
Kata Kunci: Video Tutorial, Kemampuan Kognitif, Penyelesaian soal-soal.

1. Introduction

The COVID-19 pandemic occurring in early 2020 had resulted in obligatory indirect or non-face-to-face interaction being carried out in every field, including in the field of education. The previously

face-to-face learning process should be transformed into online learning using devices as a learning tool.

However, online learning could not be carried out as effectively as offline learning, as suggested by the results of a survey involving the 11th-grade science program students in one of the senior high schools in Malang, Indonesia. The results showed that students experience difficulties in comprehending the learning materials, especially in the physics, mathematics, and chemistry courses. These three subjects were perceived as challenging subjects as the students did not have the ability to understand the concepts, count, and solve question items requiring calculation.

Learning on subjects that requires calculation analysis can be challenging without direct and detailed explanation. Linearly, the students also face challenges if the learning materials and exercises are delivered through the online learning platform [1]. Further, studies have reported that some teachers only give assignments with no adequate material explanation in every online learning [2][3]. Consequently, the students prefer to do the easiest way to complete the assignment by merely copying the accessible answer from the Internet without really learning the material. The learning becomes ineffective if the teachers monotonously give exercises without describing the materials. Besides, many students in the science program express difficulties in the physics course [4].

Eventually, teachers can use accessible interactive videos to explain the learning material in an online classroom. With interactive learning videos, the teachers can provide various learning process that does not only contain lecturing. Moreover, in the senior high school levels, the students mostly have excellent skills in operating devices.

Arfianingsih (2020) has developed a tutorial learning video on the topic of heat. The developed tutorial video presents a mere tutorial with no addition of other media that ease the material comprehension [5]. Prayatna (2018) has also constructed a tutorial video in the mathematics course, consisting of the procedures of finishing the mathematics exercises, but the provided explanation or solution is only in the form of texts, and the answers are not presented gradually. The direct (non-gradual) exercise items' completion procedure is not applicable to students with moderate cognitive skills. Students have to regularly develop their cognitive skills [5][6], primarily during the recent changes in learning. This study developed a tutorial video to solve physical exercises using critical thinking tricks and animation that clarifies the exercise items so that the students can well receive the online learning material and work on the exercises from the teachers. Besides, the tutorial video also provides solvency (solution) for the exercise items gradually to ask the students to think during the process. The tutorial videos also enhance students' higher interest in understanding the problems than merely using textbooks [6].

A great learning tutorial video has numerous indicators, such as being easily accessible, having a detailed and clear presentation, having clear and interesting texts and pictures, along with clear video sound [9]. Additionally, a good tutorial video should also have students, ease of use, cost or time, teaching, interaction, organizational issue, networking, and security, as well as privacy [7]. In this study, the tutorial video was constructed following the indicators of good and excellent tutorial videos. Primarily, the tutorial video developed in this study contained the procedures to resolve the exercise items with themes of temperature and heat, with interactive shift and animation to aid the students in understanding the exercise items. Besides, our developed tutorial video also has tricks to solve the physics exercise faster. This study aims to develop a tutorial video to help students learn physics without face-to-face explanations from the teachers.

2. Research Method

This research and development used the 4D model, consisting of defining, designing, developing, and disseminating. However, in this study, we only used the define, design, and developmental stages as we only created a tutorial video and examined the video's feasibility to be used in online learning.

Our developed video subsisted of temperature, heat, and heat transfer themes, with subthemes of temperature, thermometer, thermal expansion, heat, black principle, and heat transfer. These six sub-themes were selected based on previous studies reporting that students have 20% fewer scores in those sub-themes [8]. Thus, the students need to have more explanation on those sub-themes.

This study was carried out in October 2020 in State Senior High School 9 Malang. Our participants were 11th-grade science program students. Initially, we carried out problem analysis through a survey, followed by validity and readability tests, of the produced tutorial product. Before

the testing, the product was validated by two physics lecturers and one physics teacher concerning the product's content and construct.

The obtained data were analyzed using the same procedures performed in previous studies conducted by Suyanto and Sartinem (2009) [18]. The criteria for the product's validity, as well as the product's feasibility and readability, are presented in Tables 1 and 2, respectively.

Table 1. Criteria for Product Validity

Score	Criteria
3.26 – 4.00	Valid (without revision)
2.51 – 3.25	Sufficiently valid (minor revision)
1.76 – 2.50	Less valid (major revision)
1.00 -1.75	Not valid (total revision)

Table 2. Criteria for Product Feasibility and Readability

Percentage	Criteria
76 - 100%	Feasible and Readable
51 – 75%	Sufficiently Feasible and Readable
26 – 50%	Less Feasible and Readable
10 – 25%	Not Feasible and Readable

3. Results and Discussion

3.1 Results

The developed tutorial video's content and construct were classified as valid. The results of the product's content and construct validity are shown in Tables 3 and 4, respectivelys.

Table 3. Recapitulation of Content Validity Results

Score Range	Criteria	Item Number
3.26 – 4.00	Valid (without revision)	1,3,4,5,6,7,8,9,10,11,12,13,14
2.51 – 3.25	Sufficiently valid (minor revision)	2
1.76 – 2.50	Less valid (major revision)	-
1.00 -1.75	Not valid (total revision)	-
Average Score/Criteria		3.79/valid

Table 4. Recapitulation of Construct Validity Results

No.	Aspect	Final Score
1.	Attractiveness of video display	4
2.	Video animation	4
3.	Display of the tutorial video	3.75
4.	Language	3.67
5.	Product Operational	4
Average Score/Criteria		3.79/valid

After the validation involving validators, the product's feasibility and readability test was carried out on the 11th-grade science program students of a senior high school. The feasibility and readability test results are presented in Tables 5 and 6. The feasibility and readability results are categorized as valid.

Table 5. Recapitulation of Tutorial Video's Feasibility Test Results from Students

Aspects	Feasibility Percentage
Tutorial video's ease of access	91.3%
Tutorial video's role in the learning process	88.7%
Student's easiness in understanding the procedures to solve the question item in the tutorial video	77.5%
Easiness in understanding the discussion of items' answers	90%
Tutorial video's feasibility	91.3%
Effectiveness and practicality of the tutorial video	71.2%
Average/criteria	85.0%/valid

Table 6. Recapitulation of Tutorial Video's Readability Test Results from Students

No.	Aspects	Percentage
1.	Attractiveness of video display	91.2%
2.	Video animation	93.0%
3.	Display of tutorial video	
	Suitability of question item placement	89.4%
	Clarity of font's size and types of the question item	87.7%
	Suitability of the answer discussion placement	89.4%
	Clarity of font's size and types in the answer discussion	86.0%
	Color composition	94.7%
	Layout of illustration and ornaments	91.2%
4.	Language	
	Clear and communicative	87.7%
	Have no ambiguity	94.7%
	Clarity of sound	93.0%
5.	Product operational	
	Tutorial video's ease of access	91.2%
Average/criteria		90.76%/valid

3.2 Discussion

As presented in Tables 3 and 4, the developed tutorial video obtained the same content and construct validity score of 3.79, categorized as valid. Our tutorial video has presented various tutor displays similar to the tutoring carried out by the teachers or instructors [9]. Besides, our tutorial video also contains numerous concepts, principles, formulas, explanations, and exercises [10], presented in the form of texts, pictures, audio, and graphics.

The first chapter is about the concept of temperature. Students are reported to have difficulties in reading and understanding the graphic of temperature change and change of shape [8]. Consequently, the tutorial consists of a question item on the water condition being heated at 100 degrees. The item aims to help students comprehend the position of an object in the graphic when it experiences changes in temperature or changes in shape.

The second chapter is thermometer conversion. This topic was selected due to students are reported to have challenges in converting the value from Fahrenheit to Kelvin [11] and have a minimum understanding of the proper temperature measurement tool [12]. Therefore, in the tutorial video, three items (no 2, 3, and 4) discuss this topic. In item no 2, students are given an illustration of different temperatures felt by someone's hands, then they are asked to explain the rationale behind the phenomena. This item aims to aid students in comprehending the correct temperature measurement tool. Meanwhile, items 3 and 4 discuss the value conversion of all types of thermometers.

In the third chapter, the students are presented with the thermal expansion topic. They are provided with three question items and a complete tutorial to finish them. Those items discuss length, solid, and volume expansion. The fourth chapter discusses heat and specific heat. Many studies have suggested that students have a misconception about heat material [13], [14] and have minimum comprehension of the differences between heat and specific heat, along with their effects [15]. Therefore, in the tutorial video, two items (no 8 and 9) discuss heat and specific heat materials.

The fifth chapter discusses the black principle being used in daily life. The tutorial on this topic adopts the daily problems experienced by students. A study reported that students still presume when two objects with different temperatures are placed closer, then their mix temperature is calculated by adding up the temperature of those objects [15], representing their minimum understanding of the concept of mix temperature [15], [4]. The topic in the last chapter is heat transfer. In the tutorial video, the students are provided with a discussion on heat flow rate through radiation and convection since students still have many mistakes on this topic [16]. Many students still believe that the example of convection is when they boil water.

Our analysis results on the feasibility and readability tests showed that the developed tutorial video is classified as valid. As presented in Table 5, this tutorial video attains an 85.0% feasibility score, while Table 6 shows that our product has a 90.76% readability score. As both feasibility and readability scores are within the range of 80 - 100%, the developed tutorial video is classified as a valid product. The validity of a product reflects its feasibility to be implemented in a learning process, primarily in online learning. Besides, the developed tutorial video is also capable of helping the students to resolve the question item. Once the students present the ability to solve the physics exercises provided by the teachers, then the learning objective, especially in the development of students' cognitive skills, is successfully obtained.

Previous studies have developed tutorial videos being used as learning media. Septianty has developed a tutorial video on electricity topics for the 12^{th} grade of senior high school, obtaining a feasibility score of 3.33 [17]. A study from Pujawan has also developed a tutorial video that is tried out and attained 90% result, classified as great [10]. Another study investigating a tutorial video has also been carried out by Prayatna et al. on the mathematics course, resulting in 76% of students who successfully obtained the minimum score [9]. Even if many previous studies have investigated the use of tutorial videos in an online learning process, this study develops a tutorial video with attractive discussion on procedures to answer the question, pictures and animation that help students understand the question, as well as particular tricks and formulas to resolve the question faster.

Linear with the results of previous relevant studies, our developed tutorial video has attained a 3.26 validity score, as well as an 80% score from the limited tryout. Therefore, our developed tutorial video is categorized as valid and capable of being implemented as learning media, primarily in online learning, since it enhances students' cognitive skills in the physics course.

4 Conclusion

This research and development produce a tutorial video with topics on temperature, heat, and heat transfer that enhance students' cognitive skills. The product feasibility and readability test was investigated through a tryout involving 57 11^{th}-grade senior high school students. The results showed the feasibility and readability scores of 85 and 90.76%, respectively, classified as valid (requiring no revision). Therefore, this developed tutorial video can be used as learning media, especially in online learning. Additionally, during the tryout process, the developed tutorial video also attained positive responses from the participants. However, this study still has limitations since it only develops a tutorial video on the heat and temperature materials while also only involving 11^{th}-grade senior high school students. Thus, future studies are suggested to create tutorial videos on different physics materials for other grades.

Acknowledgment

This research and development have been successfully carried out due to massive support from numerous stakeholders. Therefore, we would like to address our most sincere gratitude to State Senior High School 9 Malang for its help in the completion of this study.

References

[1] M.F. Setiawan, Mawardi, and E. Sumadiningrat, "Pengembangan Media Video Tutorial dalam Pembelajaran Prakarya pada Kerajinan Mmembatik di Kelas V SDITQ Abu Bakar Ash-Shidiq Kabupaten Tangerang", *Jurnal Halaqah*, vol. 3, no. 4, pp. 130-137, 2021.

[2] F. Hanum and H.A. Yanuarita, "Efektivitas Pembelajaran Dalam Jaringan (Daring) selama Pandemi Covid-19 di Kabupaten Jombang", *Jurnal Ilmu Sosial dan Pendidikan*, vol. 4, no. 4,

pp. 468-473 , 2020. http://dx.doi.org/10.36312/jisip.v4i4.1559.
[3] J. Simanjuntak, dkk, "Analisis Kegiatan Pembelajaran Pendidikan Matematika pada Masa Pandemi COVID-19 di Negara Asia (Indonesia, Jepang, dan Filipina)", *SEPREN: Journal of Mathematics Education and Applied,* vol. 2, no. 2, pp. 47-55, 2021.
[4] E. Purwanto and Winarti, "Representasi Miskonsepsi Peserta Didik pada Materi Suhu dan Kalor", *Papua Journal of Physics Education (PJPE),* vol. 1, no. 1, pp. 28-35, 2020. DOI: https://doi.org/10.31957/pjpe.v1i1.1279.
[5] D. Arfianingsih, dkk, (2020). "Analisis Kemampuan Kognitif Siswa Kelas VII SMP Negeri 19 Palu dalam Pembelajaran Fisika pada Materi Kalor", *Jurnal Pendidikan Fisika Tadulako Online,* vol. 8, no. 3, pp. 26-31, 2020.
[6] R. Tampubolon, R. Erina & N.S. Rezeki, "Pengaruh Model Kooperatif Berbantuan Media Video terhadap Kemampuan Kognitif Siswa SMA Swasta Gajah Mada Medan T.P 2018/2019", *Jurnal Penelitian Fisikawan,* vol. 3, no. 1, pp. 18-24, 2020. http://jurnal.darmaagung.ac.id/index.php/jurnalpenelitianfisikawan/article/view/870
[7] A.W. Bates, "*Teaching in a Digital Age -Second Edition* (2 ed.)". Tony Bates Associates Ltd, 2019.
[8] W. Winarti and I.S. Budiarti, "Diagnostik Konsepsi Siswa pada Materi Suhu dan Kalor", *Jurnal Ilmu Pendidikan Indonesia,* vol. 8, no. 3, pp. 136-146, 2020. DOI: https://doi.org/10.31957/jipi.v8i3.1337.
[9] I.P.A.D Prayatna, P.S.I. Gusti, and G.I. Nyoman, "Penerapan Pembelajaran Matematika Berbantuan Video Tutorial untuk Meningkatkan Minat dan Prestasi Belajar Matematika Siswa Kelas VIII D SMP Negeri 2 Sawan", *Jurnal Pendidikan Matematika Undiksha,* vol. 9, no. 2, pp. 41-51, 2018.
[10] K.A.H. Pujawan, "Pengembangan Multimedia Interaktif Berbasis Video Tutorial pada Mata Kuliah Multimedia 1 (*Design Grafis*) di Politeknik Ganesha Guru",.*Journal of Education Technology,* vol. 2, no. 1, pp. 61-66, 2019. DOI: http://dx.doi.org/10.23887/jet.v2i1.13810.
[11] I.P. Viratama, "Faktor-Faktor yang Mempengaruhi Pemahaman Siswa pada Konsep Suhu dan Kalor", *Waniambey: Journal of Islamic Education,* vol. 1, no. 1, pp. 13-20, 2020.
[12] H. Karlina, Nurimani, and A. Rukyat, "Hubungan antara Pemahaman Konsep Perbandingan Hasil Belajar IPA pada Materi Suhu", *Prosiding Seminar Nasional Pendidikan STKIP Kusuma Negara II,* pp. 174-179, 2020.
[13] E.W.N. Sofianto and R.K. Irawati, "Upaya Meremediasi Konsep Fisika pada Materi Suhu dan Kalor", *Southeast Asian Journal of Islamic Education,* vol. 2, no. 2, pp. 109-124, 2020. https://doi.org/10.21093/sajie.v2i2.2188.
[14] M.D.M. Puspitasari, "Investigasi Strategi Pemecahan Masalah dan Penguasaan Konsep pada Materi Kalor", *Jurnal Riset Pendidikan Fisika,* vol. 3, no. 2, pp. 1-6, 2018. DOI: http://dx.doi.org/10.17977/um058v3i2p1-6.
[15] R. Musa'adah and S, "Kusairi Analisis Penguasaan Konsep Materi Suhu Kalor pada Pembelajaran *Cognitive Apprenticeship* (CA) disertai *Formative E-Assessment", Jurnal Riset Pendidikan Fisika (JRPF),* vol. 4, no. 2, pp 85-90, 2020.
[16] Y.E. Faiqoh, Yushardi, and A. Harijanto, "Kemampuan Penalaran Ilmiah Siswa Kelas XI SMAN di Banyuwangi Kota Materi Suhu dan Kalor", .*Jurnal Pembelajaran Fisika,* vol. 9, no. 1, pp. 11-16, 2020. doi: https://doi.org/10.19184/jpf.v9i1.17936.
[17] R.D.P. Septianty, "Pengembangan Video Tutorial Penyelesaian Soal untuk Melatihkan Keterampilan Berpikir Kritis Siswa pada Materi Kelistrikan SMA", Skripsi tidak diterbitkan. Lampung: FMIPA UNILA, 2018.
[18] E. Suryanto and Sartinem, "Pengembangan Contoh Lembar Kerja Fisika Siswa dengan Latar Penuntasan Bekal Awal Ajar Tugas Studi Pustaka dan Keterampilan Proses untuk SMA Negeri 3 Bandarlampung", *Prosiding Seminar Nasional Pendidikan,* vol. 1, no. 6, 2009.