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The Practicality of Interactive Multimedia Based on Scientific Approach in Pascal's Law Material for High School Students

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ABSTRACT

This study aimed to determine the practicality of interactive multimedia based on a scientific approach to the learning process of Pascal's Law for high school students. This study used a questionnaire instrument consisting of five items, namely (1) media attractiveness and accessibility, (2) media structure and understanding, (3) training and concept mastery, (4) additional aspects, and (5) the impact of using multimedia. The subjects of this study involved physics teachers and 11th-grade MIPA students at Ar Rohmah IIBS Malang High School. The sampling technique in this study was convenience sampling. The data obtained were analyzed using quantitative methods with descriptive analysis techniques. Based on the study results, the percentage of multimedia practicality assessed by teachers reached 85%, while those assessed by students reached 96%. Based on these percentage values, this interactive multimedia based on a scientific approach to the learning process of Pascal's Law for high school students is classified as practical and can be further tested for effectiveness.

Introduction

Physics education is a crucial foundation for understanding how the universe works through the basic principles and laws of nature that govern the universe. Through this, physics contributes widely in various fields. By understanding physics, students can develop critical and analytical thinking skills in solving problems in multiple aspects of life (Novitasari et al., 2017). Physics helps students understand natural phenomena, one of which is mechanics. Mechanics focuses on concepts related to the motion of an object. Based on their material state, mechanics can be grouped into solid and fluid mechanics (Ningrum & Linuwih, 2015).

Static fluid is a part of fluid mechanics focusing on fluid phenomena at rest (Widodo & Yuliati, 2018). Static fluid material includes the law of hydrostatic pressure, Pascal's Law, Archimedes' Law, surface tension, capillarity, viscosity, and Stokes' Law (Purnamasari et al., 2017). Static fluid is essential to learn because it is widely applied in everyday life, one of which is using hydraulic brakes on vehicles that apply the concept of Pascal's Law. In addition, there are findings that 87.7% of students do not understand the concept of static fluid (Prastiwi et al., 2018), and 21% of students have difficulty with static fluid material (Nurul, 2022). Students' difficulties in understanding the concept of static fluid, one of which is in Pascal's Law, namely: (1) 78.33% of students have difficulty in determining a hydraulic system that can lift weights (Kiranti et al., 2019) (2) 66.66% of students could not determine the amount of pressure in Pascal's Law through a case (Kiranti et al., 2019) and (3) 69.23% of students still answer incorrectly in the case example of the application of Pascal's Law (Adisna et al., 2020). This problem is caused by several things, such as the conventional teaching style of the teacher so that students are less

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actively involved during the learning process (Hanni et al., 2018), lack of qualified media and teaching materials (Azizul et al., 2020) as well as the general knowledge that students already have before learning (Taqwa et al., 2020).

To overcome this problem, using interactive multimedia in learning can be an effective solution (Ilahi et al., 2021). Interactive multimedia helps students not only know and memorize physics concepts but also understand, master, and relate these concepts to the application of everyday life (Liza, 2021). Thus, students can build a complete and better understanding so that it is easier to solve physics problems through a case. Some studies reveal that learning using interactive multimedia will positively affect students in improving concept mastery and student learning outcomes (Diyana et al., 2020; Liliana et al., 2020)

Making interactive multimedia, one of which can use Microsoft PowerPoint (PPT). *Microsoft PowerPoint* is a tool for visualization through text, images, animation, sound, and video. It has hyperlink features and interactive buttons to increase presentation liveliness (Candra et al., 2020). In addition, the program is very simple to use in the Microsoft PowerPoint application, making it easy for users. Interactive PowerPoint is significantly proven to improve student learning in the classroom and contribute to better grade attainment, so it can help enhance concept understanding (Hill et al., 2012). Other studies have also shown that the application of PowerPoint positively affects students' concept understanding (Santhalia & Sampebatu, 2020).

Integration with learning methods such as the scientific approach can be done to support the more effective use of Microsoft Power Point in developing interactive multimedia. The scientific approach actively involves students constructing concepts, laws, or principles through observation, data collection, experimentation, and conclusions, which can build deep student understanding (Fadhilaturrahmi, 2017). Previous research shows that this approach effectively improves students' physics learning outcomes and activities in the classroom (Doyan et al., 2020; Purwari, 2020). Other studies have also found that applying the scientific approach improves students' understanding of concepts (Perwita et al., 2019; Sari et al., 2019).

Based on the above considerations, the author developed an interactive multimedia based on the scientific approach to Pascal's Law material for high school students using Microsoft PowerPoint (PPT). This development was carried out through a Research and Development (R&D) approach that allows gradual product development from initial design and testing to field trials (Waruwu, 2024). The R&D approach not only focuses on product development but also provides a framework for assessing the practicality and effectiveness of the product once it has been used in real-world situations (Okpatrioka, 2023). Therefore, this study aims to test the practicality of interactive multimedia based on a scientific approach to learning Pascal's Law at Ar Rohmah IIBS Malang High School to determine the extent to which interactive multimedia can be practically applied in the learning process, with the hope that the results will make a significant contribution to the development of physics learning aids and become the basis for further research.

Methods

This research uses a quantitative approach to determine the practicality of interactive multimedia products on Pascal's Law after the trial. Thus, it can be used as a benchmark to assess the usability of interactive multimedia based on a scientific approach to Pascal's Law material that has been developed. Quantitative research was chosen because it can produce objective, measurable data and be analyzed efficiently (Marinu, 2023). In addition, quantitative research can minimize the subjectivity of researchers so that the results are more consistent and reliable.

The subjects of this study involved a physics teacher and 23 students of class XI MIPA SMA Ar Rohmah IIBS Malang, who were selected using a convenience sampling technique. This selection was based on the availability and ease of access of participants. Participant selection was conducted by considering the voluntary availability of students and teachers at the research location. Therefore, it is recommended that future research involve a larger sample size to obtain more representative findings.

The instrument for assessing the practicality of interactive learning media is divided into two types: practicality sheets for teachers and students. This instrument is adapted from Heinich's (2002) practicality sheet and has passed the validation process by expert lecturers, so it is declared valid. The teacher's practicality sheet measures the ease of use and practicality of learning media in teaching and learning. In contrast, the students' practicality sheet is filled in after they use the media. These two instruments provide a comprehensive picture of the media's practicality in supporting classroom learning.

This practicality questionnaire includes five items that are the focus of the assessment, namely: (1) attractiveness and accessibility of the media, (2) structure and completeness of the media, (3) practice and mastery of concepts, (4) additional features and (5) the impact of using multimedia. Each item is further broken down into questions to assess the practicality of interactive multimedia, as presented in Table 1.

Table 1
The Questions of Each Item on Interactive Multimedia

No	Item	Number of Question
1	Attractiveness and accessibility of media	1,2
2	Structure and understanding of media	3,4,5,6
3	Exercises and concept mastery	7
4	Additional features	8,9
5	The impact of using multimedia	10

The data collection technique used was a practicality questionnaire filled in by the research subjects. The data obtained was then analyzed to make decisions about the practicality of interactive multimedia based on the scientific approach. In terms of assessment, if the subject answers 'Yes,' then the student will get a score of 2, while for the answer 'No,' the student will get a 1. Analysis of the practicality test of interactive multimedia on Pascal's Law material using Equation 1.

$$N = \frac{score}{max\ score}\ x\ 100\% \qquad (1)$$

Information :

N : Value
Score : Total score obtained
Max Score : Maximum total score (20)

The reference criteria for evaluating the practicality of interactive multimedia, as shown in Table 1, are based on established standards in multimedia education research. The thresholds for the percentage of practicality were determined by analyzing previous research on the effectiveness of multimedia, including the research of Heinich and Molenda (2002). Their research showed that the practicality category of multimedia can be effectively segmented into five ranges, which allows educators to assess the applicability and effectiveness of interactive multimedia tools based on learner feedback and engagement.

The reference criteria for the practicality of interactive multimedia are presented in Table 2.

Table 2
Reference Criteria for Interactive Multimedia Practicality

No	The average score (%)	Category
1	85 < score ≤ 100	Practical
2	70 < score ≤ 85	Quite Practical
3	55 < score ≤ 70	Less Practical
4	score ≤ 55	Impractical

(Heinich, 2002)

The statistical technique used in this research is descriptive analysis through percentage calculation, which aims to measure interactive multimedia's practicality level based on the criteria categories set by Heinich (2002).

Result and Discussions

Interactive multimedia based on the scientific approach is made in the form of software using Microsoft PowerPoint (PPT) and is equipped with features that support students' understanding of Pascal's Law, such as competencies, concept maps, check your knowledge, Pascal's Law material, evaluation questions, figures and applications in Pascal's Law. The 'competencies' feature explains the learning objectives to be achieved, helping students measure their progress. The 'concept map' visually presents the relationship between concepts to make it easier for students to understand the material. 'Check your knowledge' is a formative evaluation for students to discover and correct misconceptions.

The 'Pascal's Law material' feature presents interactive explanations with real application examples, while 'evaluation questions measure understanding after learning the material. In addition, the 'figures and applications' feature provides historical context and practical applications of Pascal's Law, clarifying the concept's relevance. The design of this multimedia has been organized to align with the scientific approach, ensuring that each feature supports learning outcomes and corrects misconceptions.

The material menu is presented with a scientific approach, aiming to guide students' understanding of concepts related to Pascal's Law and minimize students' misconceptions related to Pascal's Law. The material menu also presents sample and practice questions about Pascal's Law. Students and teachers can use multimedia during the learning process, and students can use it independently. Some displays of

interactive multimedia based on the scientific approach are presented in Figure 1.

Figure 1
Some Interactive Multimedia Displays are based on a Scientific Approach to Pascal's Law

The data obtained in this study are divided into teacher and student response data. Teacher response data was generated by filling out an interactive multimedia practicability questionnaire, and a value of 85% was obtained. If interpreted with Table 1, then interactive multimedia based on the scientific approach is in practical criteria. The results of the data analysis of the practicality of interactive multimedia based on the scientific approach by teachers for each questionnaire statement item are presented in Table 3.

Table 3
Practicality Data for Each Item from the Teacher's Response

Item	The Value of Practicality (%)	Category
1	75	Quite Practical
2	75	Quite Practical
3	100	Practical
4	75	Quite Practical
5	100	Practical
Total	85	Practical

Based on Table 2, the practicality score of interactive multimedia from teacher responses is in the 'Practical' category overall, with a score of 85%. However, several items received the 'Practical Enough' category, namely attractiveness and accessibility (75%), structure and understanding (75%), and additional features (75%). This shows that although multimedia is generally considered practical, there is room for improvement, especially in terms of accessibility, media structure, and additional features. The 'Practical Enough' score indicates that these features work but are not yet fully optimal in supporting learning, so improvements are needed, such as adding a variety of exercise questions to increase student effectiveness and engagement and improvements in the volume of music on the multimedia.

Student response data is generated by students filling out a practicality questionnaire after using interactive multimedia based on a scientific approach in the learning process of Pascal's Law, which consists of 23 students. The data obtained was then analyzed, and a value of 96% was obtained. Thus, interactive multimedia based on a scientific approach based on Table 1 includes the criterion Practical. The results of the data analysis of the practicality of interactive multimedia based on the scientific approach by students for each questionnaire statement item are presented in Table 4.

Table 4
Practicality Data for Each Item from Student Responses

Item	The Value of Practicality	Category
1	100	Practical
2	99	Practical
3	100	Practical
4	93	Practical
5	87	Practical
Total	96	Practical

Based on Table 3, the interactive multimedia based on the scientific approach received high practicality scores from students, a total of 96%, indicating that students found it very useful. Further analysis showed that concept mastery exercises (100%) and concept maps (99%) contributed the most to positive feedback, helping students understand Pascal's Law more clearly. These high practicality scores also correlate with increased student engagement and understanding, as seen from the high evaluation scores on each item. However, further analysis is needed to confirm a significant causal relationship between the use of multimedia and improved learning outcomes. In addition, further research with a larger and more diverse sample size is needed to increase the findings' reliability and validity and explore the broader impact on student learning.

This interactive multimedia can not only be used by teachers and students in the learning process but also has the potential to improve students' understanding of Pascal's Law and encourage their active engagement in physics learning, as seen from the results of the media's practicality value based on knowledge and engagement measured during the study. Although this interactive multimedia has shown potential to improve students' understanding and engagement, some areas still require revision based on teacher and student feedback. Teachers suggested adding a variety of practice questions and improvements to the accessibility features to facilitate student understanding further. Students suggested further development on additional features, such as setting the appropriate volume of accompanying music. This revision is expected to increase the practicality of multimedia so that it is more optimal in supporting Pascal's Law learning.

Conclusions

The results showed that interactive multimedia based on the scientific approach to Pascal's Law was considered practical by teachers and students, with a high level of practicality. However, some areas still need improvement, such as adding a variety of exercise questions and increasing accessibility, as well as improving the volume of music on multimedia. This study implies that interactive multimedia can improve students' understanding and engagement in physics learning. For future research, further testing is needed to evaluate the long-term effectiveness of this multimedia in various contexts. The limitations of this study include the limited scope of testing, so more extensive trials are needed. For educators, this multimedia can be implemented as a learning tool but needs to be adjusted to the needs of the class and students.

References

Adisna, Q. D. P. P., Wahuni, A., & Suyudi, A. (2020). Analisis Pemahaman Konsep Fisika Siswa Pada Pokok Bahasan Fluida Statis. *Jurnal Ilmu Fisika dan Pembelajarannya (JIFP)*, *3*(2), 68–75. https://doi.org/10.19109/jifp.v3i2.4632

Azizul, A., Riski, W. Y., Fitriyani, D. I., & Sari, I. N. (2020). Pengembangan Bahan Ajar Komik Digital Pada Materi Gerak. *VOX EDUKASI: Jurnal Ilmiah Ilmu Pendidikan*, *11*(2), 97–104. https://doi.org/10.31932/ve.v11i2.829

Candra, O., Elfizon, E., Islami, S., & Yanto, D. T. P. (2020). Penerapan Multimedia Interaktif Power Point Pada Mata Diklat Dasar Dan Pengukuran Listrik. *CIRCUIT: Jurnal Ilmiah Pendidikan Teknik Elektro*, *4*(2), 87. https://doi.org/10.22373/crc.v4i2.6660

Diyana, T. N., Sutopo, & Sunaryono. (2020). The effectiveness of web-based recitation program on improving students' conceptual understanding in fluid mechanics. *Jurnal Pendidikan IPA Indonesia*, *9*(2), 219–230. https://doi.org/10.15294/jpii.v9i2.24043

Doyan, A., Gunawan, G., Susilawati, S., & Putra, R. A. (2020). Pengaruh Model Pembelajaran Conceptual Understanding Procedures (Cups) Dengan Pendekatan Saintifik Terhadap Aktivitas Dan Hasil Belajar Fisika. *Jurnal Penelitian dan Pembelajaran Fisika Indonesia*, *2*(1). https://doi.org/10.29303/jppfi.v2i1.49

Fadhilaturrahmi, F. (2017). Penerapan Pendekatan Saintifik Untuk Meningkatkan Kemampuan Komunikasi Matematik Peserta Didik di Sekolah Dasar. *EduHumaniora | Jurnal Pendidikan Dasar Kampus Cibiru*, *9*(2), 109. https://doi.org/10.17509/eh.v9i2.7078

Hanni, I. U., Muslim, Hasanah, L., & Samsudin, A. (2018). K-11 students' creative thinking ability on static fluid: A case study. *Journal of Physics: Conference Series*, *1013*(1). https://doi.org/10.1088/1742-6596/1013/1/012034

Heinich, R. (2002). *Instructional Media and Technologies for Learning* (7 ed.). Merrill.

Hill, A., Arford, T., Lubitow, A., & Smollin, L. M. (2012). "I'm Ambivalent about It": The Dilemmas of PowerPoint. *Teaching Sociology*, *40*(3), 242–256. https://doi.org/10.1177/0092055X12444071

Ilahi, T. D. W., Mufit, F., Hidayati, H., & Afrizon, R. (2021). Disain dan Validitas Multimedia Interaktif Berbasis Konflik Kognitif pada Materi Vektor untuk Kelas X SMA/MA. *Jurnal Penelitian Pembelajaran Fisika*, *12*(2), 182–195. https://doi.org/10.26877/jp2f.v12i2.9324

Kiranti, G. A., Wijaya, Rusnayati, H., Wijaya, A. F. ., & Siahaan, P. (2019). Profil Hambatan Belajar Epistemologis Siswa Pada Materi Fluida Statis Kelas XI SMA Berbasis Analisis Tes Kemampuan Responden. *Zeitschrift für Kulturwissenschaften*, *13*(2), 128–136. https://doi.org/10.14361/zfk-2019-130213

Liliana, R. A., Raharjo, W., & Jauhari, I. (2020). The development of interactive learning media with lectora inspire in gas kinetic theory subject to improve the result and students' interest of the eleventh grade students of senior high school. *Journal of Physics: Conference Series*, *1567*(3). https://doi.org/10.1088/1742-6596/1567/3/032092

Liza, S. (2021). Upaya Peningkatan Minat Dan Hasil Belajar Fisika Siswa Kelas Xii.Ipa.3 Sman 3 Muaro Jambi Melalui Media Pembelajaran Animasi 3 Dimensi Tahun Pelajaran 2018/2019. *SCIENCE : Jurnal Inovasi Pendidikan Matematika dan IPA*, *1*(2), 170–176. https://doi.org/10.51878/science.v1i2.522

Ningrum, F. S., & Linuwih, S. (2015). Analisis Pemahaman Siswa Sma Terhadap Fluida Pada Hukum Archimedes. *UPEJ Unnes Physics Education Journal*, *4*(1), 33–36. https://doi.org/10.15294/upej.v4i1.4735

Novitasari, L., Agustina, P. A., Sukesti, R., Nazri, M. F., & Handhika, J. (2017). Fisika, Etnosains, dan Kearifan Lokal dalam Pembelajaran Sains. *Seminar Nasional Pendidikan Fisika III 2017*, 81–88. https://doi.org/10.2573/snpf.v0i0.1617

Nurul, D. (2022). Analisis Kesulitan Kemampuan Pemecahan Masalah Pada Pesera Didik Dalam Pembelajaran Fisika. *Jurnal Inovasi dan Teknologi Pendidikan*, *1*(1), 20–30. https://doi.org/10.46306/jurinotep.v1i1.2

Okpatrioka, O. (2023). Research And Development (R&D) Penelitian Yang Inovatif Dalam Pendidikan. *Dharma Acariya Nusantara: Jurnal Pendidikan, Bahasa dan Budaya*, *1*(1), 86–100. https://doi.org/10.47861/jdan.v1i1.154

Perwita, D. P., Rohadi, N., & Sakti, I. (2019). Pengaruh Model Learning Cycle 5E Dengan Pendekatan Saintifik Terhadap Motivasi Belajar Dan Pemahaman Konsep Fisika Di Sman 09 Kota Bengkulu. *Jurnal Kumparan Fisika*, *2*(1), 25–32. https://doi.org/10.33369/jkf.2.1.25-32

Prastiwi, V. D., Parno, P., & Wisodo, H. (2018). Identifikasi pemahaman konsep dan penalaran ilmiah siswa SMA pada materi fluida statis. *Momentum: Physics Education Journal*, *2*(2), 56–63. https://doi.org/10.21067/mpej.v1i1.2216

Purnamasari, I., Yuliati, L., & Diantoro, M. (2017). *Analisis Kemampuan Pemecahan Masalah Fisika pada Materi Fluida Statis* (hal. 191–195).

Purwari, Y. (2020). Pendekatan Saintifik dengan Metode Gasing pada Pembelajaran Fisika. *JPGI (Jurnal Penelitian Guru Indonesia)*, *5*(1), 7. https://doi.org/10.29210/02507jpgi0005

Santhalia, P. W., & Sampebatu, E. C. (2020). Pengembangan multimedia interaktif dalam membantu pembelajaran fisika di era Covid-19. *Jurnal Inovasi Pendidikan IPA*, *6*(2), 165–175. https://doi.org/10.21831/jipi.v6i2.31985

Sari, I. P., Mustikasari, V. R., & Pratiwi, N. (2019). Pengintegrasian penilaian formatif dalam pembelajaran IPA berbasis saintifik terhadap pemahaman konsep peserta didik. *JIPVA (Jurnal Pendidikan IPA Veteran)*, *3*(1), 52. https://doi.org/10.31331/jipva.v3i1.778

Taqwa, M. R. A., Suyudi, A., & Sulur, S. (2020). Analisis Miskonsepsi Topik Suhu dan Kalor Mahasiswa Pendidikan Fisika Universitas Negeri Malang. *Briliant: Jurnal Riset dan Konseptual*, *5*(3), 522. https://doi.org/10.28926/briliant.v5i3.502

Waruwu, M. (2024). Metode Penelitian dan Pengembangan (R&D): Konsep, Jenis, Tahapan dan Kelebihan. *Jurnal Ilmiah Profesi Pendidikan*, *9*(2), 1220–1230. https://doi.org/10.29303/jipp.v9i2.2141

Widodo, L., & Yuliati, L. (2018). *Penguasaan Konsep pada Hukum Archimedes Siswa SMA*. 745–750. https://doi.org/10.17977/jptpp.v3i6.11138