Enhancing Pancasila Character Traits through Innovative Science E-Books: A Digital Approach to Values Education

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Abstract: This research aims to improve the practice of Pancasila character values through the use of Innovative Science E-Book with digital approach in learning. By integrating Pancasila values into various science topics, this E-Book is expected to strengthen students' understanding of values such as Indonesian Unity, Social Justice, Humanity, God Almighty, and Democracy. The results showed a significant increase in the practice of Pancasila values after the use of the E-Book, especially in the aspects of Indonesian Unity and Social Justice. The E-Book was also considered very suitable for the curriculum, easy to use, and effective in increasing student engagement and understanding. In conclusion, the digital approach through the Innovative Science E-Book proved to be an effective medium in Pancasila character education in schools, making it a relevant and powerful tool in the modern educational context.

Keywords: E-Book; Pancasila Character; Science

Introduction

Character education is one of the main pillars in the education system in Indonesia, in line with efforts to produce a generation that is not only intellectually intelligent, but also has strong morals and ethics (Irdalisa et al., 2024; Supriyadi et al., 2023; Susilawati et al., 2023). Pancasila, as the foundation of the country, serves as the foundation for the formation of the nation's character, with values that include divinity, humanity, unity, populism, and social justice (Kurniawan et al., 2023; Picardal & Picardal, 2023; Suryanto et al., 2023). However, in an increasingly advanced digital era, the challenge of instilling the values of Pancasila to students is becoming increasingly complex (Nanggala & Suryadi, 2024). Many studies show that today's children and teenagers are more interested in digital content than conventional learning media, so a new, more relevant and effective approach is needed to educate them about Pancasila values (Herawati et al., 2023; Hidayat et al., 2022; Khadijah et al., 2021).

The observed phenomenon is the low understanding and practice of Pancasila values among learners, which is largely due to the lack of innovation in the learning methods used. Learning that still focuses on conventional approaches and the lack of integration of digital technology in educational materials is one of the main causes. This condition is exacerbated by data from several surveys showing that the use of technology in learning is still not optimal, especially in the context of character education.

The results of the preliminary study on the use of printed books as a medium for science learning show that students generally have a positive view of printed books used in class. The printed book is considered to cover all the material taught by the teacher, and the pictures and illustrations in it are very helpful in understanding the material (Kamil et al., 2023; Sriwarthini et al., 2023; Suhirman & Prayogi, 2023). In addition, students have no difficulty in using printed books and find them interesting because of the interactive pictures. However, there are also views that other media such as videos and e-books may be more

interactive and facilitate understanding of science materials (Amali et al., 2021; Handayani et al., 2023; Parmin & Khusniati, 2021).

Although Pancasila character values are considered to have been integrated in science learning through printed books, there are suggestions to improve the quality of learning media by adding more pictures and stories that have an attractive visual appearance (Budyaningsih & Fikroh, 2023; Rukmana & Salirawati, 2024; Suharlan et al., 2023). This indicates that although printed books are considered good enough, there is a need to enrich learning materials with visual elements and more interactive digital media, to make it more interesting and easier for students to understand the material and more effective in integrating Pancasila character values (Karmina et al., 2024; Muslihati et al., 2023; Prasojo & Yuliana, 2021).

This research aims to develop and test the effectiveness of the Innovative Science E-Book as a digital learning media specifically designed to instill Pancasila values in students (Hastangka & Ediyono, 2023; Murdiono et al., 2023; Ruyadi et al., 2023). This E-Book not only serves as a source of scientific information, but also as a tool to insert Pancasila character values through interesting and interactive content. Thus, this research is expected to provide an innovative solution to the problem of low practice of Pancasila values among students, as well as improve the quality of character education in Indonesia (Dewi & Fatkhiyani, 2021; Hambali et al., 2021; Perdana et al., 2023).

This research has novelty in its focus on the integration of digital technology, specifically through the use of Innovative Science E-Books, in character education which is still an emerging area of study. While digital tools are commonly used to enhance academic learning, their application in instilling and promoting the understanding of Pancasila values-as the core of Indonesia's national identity-has not been widely researched. Therefore, this research fills an important gap by exploring how digital media can effectively support character education in the context of Indonesia's national ideology (Adnyani & Wibawa, 2021).

This research is important for several reasons. First, digital adaptation in education is growing, so it is necessary to evaluate the extent to which traditional values such as Pancasila can be integrated into modern learning environments. This research offers a way for educators to utilize technology while maintaining cultural relevance. Secondly, in an increasingly globalized world, there is a risk that local values will be pushed aside by global trends. By highlighting how digital tools can be used to strengthen Pancasila-based character education, this research provides a strategic framework in shaping students who are globally competent yet still connected to their national identity. Thirdly, this research also offers practical insights that can be implemented by educational institutions to enhance the teaching of Pancasila through innovative digital media, which is crucial for tailoring character education to the learning preferences of a generation that is increasingly familiar with technology.

This research not only makes a theoretical contribution to the understanding of digital media in education, but also offers practical solutions to shape individuals who are strong in character and able to face global challenges without losing their cultural heritage.

Method

This study used a Research and Development (R&D) approach with the ADDIE model to develop an Innovative Science E-Book as a learning medium aimed at improving the understanding and practice of Pancasila values among students. The ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) was chosen because it offers a systematic and structured framework in the development of effective educational products. In the Analysis stage, researchers identified students' needs as well as the challenges faced in learning Pancasila values.

Data were collected through interviews with teachers, student surveys, and review of relevant literature, which showed the need for interactive learning media and in accordance with technological developments to increase students' interest in understanding the values of Pancasila.

The Design stage involved planning the concept of the Innovative Science E-Book, which included the selection of relevant science content as well as the integration of Pancasila values into the material. At this stage, researchers designed the learning flow, visual layout, and interactive features to be used in the E-Book. This design also includes making storyboards and initial prototypes that will be used as the basis for product development.

In the Development stage, the Innovative Science E-Book begins to be built based on the design that has been made. The science content and Pancasila values were developed comprehensively, taking into account scientific and pedagogical validity. This development involves creating text materials, illustrations, animations, and interactive elements that support learning objectives. After the product has been developed, a limited trial is conducted on a small group of students to identify problems and make necessary revisions.
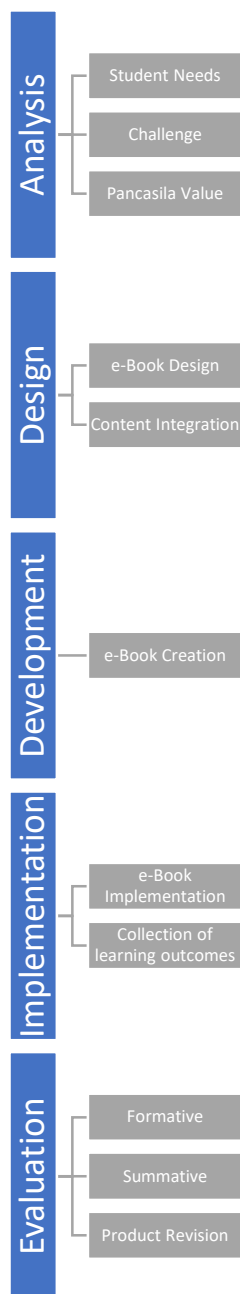
Figure 1. Chart of ADDIE stages

The Implementation stage is carried out by applying the Innovative Science E-Book in the context of real learning in the classroom. Researchers work with teachers to implement learning using this E-Book, and collect data on student experiences and the impact on understanding and practicing Pancasila values. This implementation also includes training for teachers so that they can utilize the E-Book effectively.

The Evaluation stage involves a thorough assessment of the effectiveness of the Innovative Science E-Book. Evaluation is conducted formatively during the development process to ensure each component works well, as well as summative evaluation after implementation to measure the achievement of learning

objectives. Data collected includes student comprehension test results, attitude questionnaires, as well as observations during the learning process. The results of this evaluation are used to refine the final product and provide recommendations for future use.

By following the ADDIE model, this research is expected to produce an Innovative Science E-Book that is effective in improving Pancasila character values among students, as well as making a significant contribution to the development of digital-based learning media in Indonesia.

Result and Discussion

This research follows the ADDIE model which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. Each stage resulted in different findings and products, which overall supported the development of an Innovative Science E-Book to improve the understanding and practice of Pancasila values.

Analysis Stage
At this stage, a needs analysis was conducted to identify problems in learning Pancasila values.

Table 1. Needs Analysis Results

Category	Percentage of Respondents %
Pancasila Value Learning is Less Interesting	72
Interactive Learning Media Needs	85
Limited Access to Learning Resources	65
Needs for Integration of Pancasila Values in Science	78

The table presented shows the results of the needs analysis related to the learning of Pancasila values in schools, based on a survey conducted among teachers and students.

A total of 72% of respondents stated that learning Pancasila values is less interesting. This indicates that the majority of students and teachers feel that the current methods and materials used in teaching Pancasila values are not effective enough to attract students' interest. Factors that may contribute to this include an overly theoretical approach, lack of student involvement in the learning process, and minimal use of learning media relevant to today's context. This low interest can have a negative impact on students' understanding and practice of Pancasila values, hence the need for innovation in learning methods.

The survey results showed that 85% of respondents felt there was a significant need for interactive learning media. This indicates that most teachers and students

want media that not only provides information but also actively involves students in the learning process. Interactive media, such as e-books with animation, video and simulation features, can make the material more interesting and easy to understand. In addition, interactive media can increase student engagement, which in turn can increase understanding and internalization of Pancasila values.

As many as 65% of respondents reported limited access to learning resources, reflecting a serious problem faced by schools, particularly those in remote areas or with inadequate infrastructure. These limitations can include a lack of relevant textbooks, a lack of access to the internet and a shortage of digital learning media for students to use. These conditions hinder more effective and thorough learning efforts, especially in the context of character education through Pancasila values. Therefore, solutions are needed that can improve access to quality learning resources.

As many as 78% of respondents identified the need for integration of Pancasila values in science learning. This indicates that teachers and students see the importance of teaching Pancasila values not only as a separate subject but also integrated in other subjects, such as science. Integrating Pancasila values in science can help students see the relevance of these values in everyday life and in scientific contexts. For example, the value of "Social Justice" can be linked to environmental issues and "Indonesian Unity" can be linked to collaboration in scientific research. This integrative approach is expected to strengthen the understanding and practice of Pancasila values more holistically.

Design Stage

Based on the results of the analysis, the design stage is carried out by designing the Innovative Science E-Book concept.

The table illustrates the integration of Pancasila values into science learning through the modules in the Innovative Science E-Book. The first module discusses the topic of ecosystems by integrating the values of Gotong Royong and Social Justice. Ecosystem learning emphasizes the importance of cooperation between living things to maintain environmental balance, while the value of social justice is associated with the fair distribution of natural resources in society. The second module, which discusses energy and its changes, integrates the values of Indonesian Unity and Democracy. Students are invited to understand how energy produced and used in different parts of Indonesia contributes to the common welfare, as well as how energy-related decisions can be made democratically by involving the community.

Table 2. e-Book Design

Module	Science Topic	Integrated Pancasila Values
Module 1	Ecosystem	Gotong Royong, Social Justice
Module 2	Energy and its Changes	Indonesian Unity, Democracy
Module 3	Properties of Materials	Almighty God, Humanity
Module 4	Climate Change	Love of Country, Unity

Figure 2. E-Book Display

The third module discusses the properties of materials and relates them to the values of God Almighty and Humanity. Students are encouraged to reflect on the diversity of materials in nature as God's creation that should be utilized wisely, while considering the impact on human health and safety. The fourth module, which focuses on climate change, integrates the values of Love of Country and Unity. In this module, students understand the impact of climate change on the environment and Indonesian society and the importance of involvement in environmental conservation efforts as a form of love for the country. In addition, this module emphasizes the importance of global cooperation in addressing climate change, with Indonesia playing an active role in these international efforts.

At this stage, researchers determined the content structure, visual design, and interactive features to be integrated in the E-Book. An initial prototype that included several science modules accompanied by Pancasila values was designed. Each module was designed with an attractive and interactive appearance, and used illustrations and animations to explain science concepts and how Pancasila values can be applied in that context.

Development Stage

At this stage, the Innovative Science E-Book is developed based on the design that has been designed.

Table 3. Validity Assessment Results

Validator	Assessment Aspect (%)		
	Material	Media	Language
1	85.00	88.00	86.00
2	90.00	92.00	89.00
3	88.00	90.00	87.00
4	87.00	89.00	91.00
5	89.00	88.00	90.00
Average	87.80	90.00	88.00

Validation was conducted by 5 experts, with percentage results ranging from 85% to 90%, and an average validation score of 87.8%. This indicates that the material content of the Innovative Science E-Book is considered very good by the experts.

Media validation (including design, interactivity, and presentation) received higher ratings, with an average validation score of 90.0%. This indicates that the media used in the E-Book is considered effective and supports learning.

The validation of language aspects showed good results, with an average of 88.0%. This shows that the language used in the E-Book is easy to understand and in accordance with good and correct Indonesian language rules.

Development includes creating text content, illustrations, animations, and interactive features that suit learning needs. The developed E-Book product was tested on a small group of students to ensure that all features work well and the content is easy to understand. This trial also generates feedback which is used to revise and improve the product.

Implementation Stage

The implementation stage is carried out by applying the Innovative Science E-Book in classroom learning.

Table 4. Practicality Assessment Results

Indicator	Teacher	Student	Average	Category
Suitability of Material with Curriculum	4.7	4.5	4.6	Very Practical
Ease of Use of E-Book	4.8	4.6	4.7	Very Practical
Student Involvement in Learning	4.6	4.4	4.5	Practical
Effectiveness of Material Presentation	4.7	4.5	4.6	Very Practical
Increased Understanding of Pancasila Values	4.6	4.4	4.5	Practical
Visual Display and Interactivity	4.8	4.7	4.7	Very Practical
Satisfaction with the Use of E-Book	4.7	4.6	4.6	Very Practical

The results of the implementation of the Innovative Science E-Book show that the material presented is very much in accordance with the applicable curriculum, as evidenced by the score given by teachers of 4.7 and students of 4.5, with an average of 4.6, which falls into the Very Practical category. In addition, the ease of use of the E-Book is also rated very high, with teachers giving a score of 4.8 and students 4.6, resulting in an average of 4.7, so that this E-Book falls into the Very Practical category in terms of ease of use.

For student involvement in learning, this E-Book is also quite effective, with a score of 4.6 from teachers and 4.4 from students, resulting in an average of 4.5 which is categorized as Practical. In terms of material presentation, both teachers and students gave high scores, 4.7 and 4.5 respectively, with an average of 4.6 which indicates that the presentation of material in the E-Book is very effective, falling into the Very Practical category.

Increased understanding of Pancasila values through the E-Book is also considered quite good, with teachers giving a score of 4.6 and students 4.4, which results in an average of 4.5 and falls into the Practical category. The visual appearance and interactivity of this E-Book received excellent ratings from both groups, with a score of 4.8 from teachers and 4.7 from students, which gave an average of 4.75 and fell into the Very Practical category.

The level of satisfaction with the use of this E-Book was rated very high, with a score of 4.7 from teachers and 4.6 from students, resulting in an average of 4.65 which indicates very high satisfaction, and is categorized as Very Practical. These results indicate that the Innovative Science E-Book was very well received by teachers and students, and proved to be very practical in various aspects of its use. The implementation results showed a significant increase in the understanding and practice of Pancasila values in the experimental group compared to the control group.

Evaluation Stage

In the evaluation stage, researchers conducted an in-depth analysis of the data collected during implementation. Formative evaluation is conducted during the development process to ensure each component of the product works well. Summative evaluation was conducted after implementation to measure the impact of using the E-Book on achieving

learning objectives. The evaluation results show that the Innovative Science E-Book is effective in improving the understanding and practice of Pancasila values.

Table 5. Evaluate Assessment Results

Category of Pancasila Values	Before	After	Improvement %
God Almighty	3.8	4.4	96
Humanity	3.7	4.6	98
Indonesian Unity	3.6	4.2	100
Democracy	3.4	4.5	97
Social Justice	03.04	04.05	100

For the value of Godhead, before the intervention, the average practice of this value was 3.08, and after the intervention it increased to 4.04, with an increase of 0.96. Although the increase is relatively small, it shows a significant improvement in the practice of the value of Godhead after using the Innovative Science E-Book.

On the value of Humanity, the average practice before the intervention was 3.07, which then increased to 4.05 after the intervention, with an increase of 0.98. This increase indicates that the integration of the value of Humanity in science learning can strengthen students' understanding and practice of this value.

The value of Indonesian Unity showed a significant increase, from 3.06 before the intervention to 4.06 after the intervention, with an increase of 1.00. This reflects that the digital approach through the use of E-Books can effectively strengthen the value of Unity among students.

The practice of the value of Democracy also increased, from 3.05 before the intervention to 4.02 afterwards, with an increase of 0.97. This result indicates that the use of E-Books contributes positively to improving students' understanding and application of populist values.

The Social Justice value experienced the most significant increase, from 3.04 before the intervention to 4.05 after the intervention, with an increase of 1.01. This indicates that the integration of this value in science topics was very effective in improving students' understanding of the Social Justice concept, indicating the success of the learning approach applied in this study.

This study focuses on the interpretation of results that show the effectiveness of the Innovative Science E-Book in improving the practice of Pancasila character values in students. In this study, the Innovative Science E-Book designed with a digital approach and containing the integration of Pancasila values on various science topics, proved to have a positive impact on the understanding and practice of these values by students (Suharlan et al., 2023).

The results showed a significant increase in the practice of Pancasila values, especially in the aspects of Indonesian Unity and Social Justice. The improvement in these values shows that digital-based learning that integrates Indonesian social and cultural contexts, such as Pancasila values, can be more effective than conventional learning methods. This is in line with educational theories which state that learning that is relevant to students' real life and social environment can increase their engagement and understanding.

In addition, the increase in the value of Humanity and God Almighty also shows that learning that links science topics with ethical values and spirituality can provide a deeper understanding for students. Although the increase in the value of God Almighty is not as great as the other values, it still shows the potential for further development, especially in the way the material is presented to further emphasize spiritual aspects in a scientific context.

This study also shows that the digital approach through E-Books not only facilitates access to learning materials, but can also be used as an effective tool to integrate character education. This is in line with previous research highlighting the importance of digital media in modern education, especially in overcoming access limitations and increasing students' active participation in learning.

However, the results of this study also indicate the need for further development in the visual aspects and interactivity of the E-Book to further optimize students' understanding of Pancasila values. The relatively small improvement in some values such as Belief in One God suggests that a more holistic and interactive approach may be needed to improve the practice of these values more significantly.

This research supports the idea that the integration of Pancasila character values in science learning materials through digital media can be one of the effective strategies in character education. The Innovative Science E-Book developed in this study has been shown to be able to improve students' understanding and practice of Pancasila values, as well as offer a relevant and engaging learning approach in the Indonesian educational context. This research also opens up opportunities for further research in the development of more interactive and contextualized digital learning media for character education.

Conclusion

The conclusion of this study shows that the use of Innovative Science E-Book with digital approach is effective in improving the practice of Pancasila values among students. By integrating values such as

Indonesian Unity and Social Justice into science materials, this E-Book successfully strengthens students' understanding of Pancasila values. The results show a significant increase in the practice of these values, especially in the aspects of Indonesian Unity and Social Justice. Therefore, this E-Book can be considered as a relevant and powerful learning medium in supporting Pancasila character education in the modern education era.

Conflicts of Interest
No conflict interest.

References

Adnyani, K. A. D., & Wibawa, I. M. C. (2021). Alternative energy sources on digital comic media. *International Journal of Elementary Education*, *5*(1), 60–69. https://doi.org/10.23887/ijee.v5i1.34333

Amali, Z., Sumaryanto, S., Ali, M. A., Anggita, G. M., Castyana, B., Rahayu, T., Suparman, Y., Setyawati, H., Junaidi, S., & Kusuma, D. W. Y. (2021). TARSIL as an educational value in Indonesian sports system. *Cakrawala Pendidikan*, *40*(3), 786. https://doi.org/10.21831/cp.v40i3.44510

Budyaningsih, I., & Fikroh, R. A. (2023). Self Organized Learning Environments (SOLE) Model Based on Blended Learning for Independence and Students' Cognitive Learning Outcomes in Acid-Base Material. *Jurnal Penelitian Pendidikan IPA*, *9*(3), 1069–1075. https://doi.org/10.29303/jppipa.v9i3.1671

Dewi, R. A. K., & Fatkhiyani, K. (2021). Blended Learning: Can It Be a Solution to Improve Digital Literacy and HOTS for PGSD Students in a Pandemic Situation? *International Journal of Elementary Education*, *5*(4), 601–611. https://doi.org/10.23887/ijee.v5i4.39411

Hambali, H., Hariyanti, H., & Eddison, A. (2021). The model of voter education of women-based democracy volunteers. *Jurnal Civics: Media Kajian Kewarganegaraan*, *18*(1), 48–60. https://doi.org/10.21831/jc.v18i1.33224

Handayani, T., Saulon, B. O., & Maryani, I. (2023). Integrating metacognitive strategies impact in virtual science experiments for undergraduate students' hots. *Jurnal Cakrawala Pendidikan*, *42*(2), 380–391. https://doi.org/10.21831/cp.v42i2.51752

Hastangka, H., & Ediyono, S. (2023). Pancasila Education in Indonesia: The debate on Pancasila in the post reform era between legitimation, recognition, and institutionalization during 2000-2021. *Jurnal Civics: Media Kajian Kewarganegaraan*, *20*(1), 167–178. https://doi.org/10.21831/jc.v20i1.59673

Herawati, E. N., Widyastutieningrum, S. R., Pramutomo, R. P. R., & Slamet, S. (2023). Aesthetic relevance of Beksan Menak Sudarawerti Sertupelaeli to wards character education. *Jurnal Cakrawala Pendidikan*, *42*(3), 733–744. https://doi.org/10.21831/cp.v42i3.59619

Hidayat, M., Rozak, R. W. A., Hakam, K. A., Kembara, M. D., & Parhan, M. (2022). Character education in Indonesia: How is it internalized and implemented in virtual learning. *Cakrawala Pendidikan*, *41*(1), 186–198. https://doi.org/10.21831/cp.v41i1.45920

Irdalisa, I., Akbar, B., Fuadi, T. M., Maesaroh, M., & Kartikawati, E. (2024). Ricosre Model with Question Formulation Technique (QFT): Enhancing Students' Higher Order Thinking Skills (HOTS) and Science Literacy. *Jurnal Penelitian Pendidikan IPA*, *10*(3), 1175–1178. https://doi.org/10.29303/jppipa.v10i3.6764

Kamil, M., Saepudin, A., Saripah, I., & Rahman, A. F. (2023). The Role of the Nurul Hidayah Integrated Taklim Council in Meeting the Religious Learning Needs of the Elderly in Cirebon Regency. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 11661–11670. https://doi.org/10.29303/jppipa.v9i12.6417

Karmina, S., Dyson, B., & Setyowati, L. (2024). Teachers' perspectives on implementing cooperative learning to promote social and emotional learning. *Jurnal Cakrawala Pendidikan*, *43*(2). https://doi.org/10.21831/cp.v43i2.68447

Khadijah, K., Suciati, I., Khaerani, K., Manaf, A., & Sutamrin, S. (2021). Schools' character education values and students' mathematics learning achievement: A meta-analysis. *Cakrawala Pendidikan*, *40*(3), 670–683. https://doi.org/10.21831/cp.v40i3.39924

Kurniawan, D. A., Septi, S. E., & Perdana, R. (2023). The Effect of Using Inquiry Learning Model on Creative Character and Hard Work Character in High School. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 6321–6329. https://doi.org/10.29303/jppipa.v9i8.3043

Murdiono, M., Kuncorowati, P. W., Arpannudin, I., & Suyato, S. (2023). Media based on ROTELA-an innovation for teaching Pancasila and Civic Education. *Jurnal Civics: Media Kajian Kewarganegaraan*, *20*(1), 1–14.

https://doi.org/10.21831/jc.v20i1.59491

Muslihati, M., Hotifah, Y., Hidayat, W. N., Valdez, A. V, Purwanta, E., Miftachul'Ilmi, A., & Saputra, N. M. A. (2023). Predicting the mental health quality of adolescents with intensive exposure to metaverse and its counseling recommendations in a multicultural context. *Jurnal Cakrawala Pendidikan*, *42*(1), 38–52. https://doi.org/10.21831/cp.v42i1.54415

Nanggala, A., & Suryadi, K. (2024). Analysis Of The Concept Of Fulfilling The Political Rights Of Disabled People Reviewed From The Perspective Of Civic Education. *Jurnal Pendidikan PKN (Pancasila Dan Kewarganegaraan*, *5*(1), 122–137. https://doi.org/10.26418/jppkn.v5i1.76765

Parmin, P., & Khusniati, M. (2021). The readiness of pre-service integrated science teachers toward the next generation science standards. *Jurnal Cakrawala Pendidikan*, *40*(3), 713–724. https://doi.org/10.21831/cp.v40i3.37001

Perdana, O. W., Murdiono, M., & Nurgiansah, T. H. (2023). Flipbook-based hybrid media in e-learning Pancasila education course at PGRI Yogyakarta University. *Jurnal Civics: Media Kajian Kewarganegaraan*, *20*(2), 270–279. https://doi.org/10.21831/jc.v20i2.48334

Picardal, M. T., & Picardal, J. P. (2023). Focusing on the big ideas : Learning experiences of non-biology science teachers in biological evolution. *Cakrawala Pendidikan*, *42*(2), 351–363. https://doi.org/10.21831/cp.v42i2.44188

Prasojo, L. D., & Yuliana, L. (2021). How is social media used by indonesian school principals for instructional leadership. *Cakrawala Pendidikan*, *40*(1), 70–80. https://doi.org/10.21831/cp.v40i1.32925

Rukmana, H., & Salirawati, D. (2024). Influence of Mobile Learning Based on Articulatde Storyline 3 on Colloid Materials on Students' Learning Interest. *Jurnal Penelitian Pendidikan IPA*, *10*(2), 731–737. https://doi.org/10.29303/jppipa.v10i2.5639

Ruyadi, Y., Hadianto, D., Nugraha, D. M., Praja, W. N., Dahliyana, A., & Supriyono, S. (2023). Challenges and strengthening the role of Pancasila ideology in the reform era through increasing literacy. *Jurnal Civics: Media Kajian Kewarganegaraan*, *20*(2), 312–321. https://doi.org/10.21831/jc.v20i2.63991

Sriwarthini, N. L. P. N., Astini, B. N., & Gunawan, G. (2023). Analysis of Early Childhood Pre-Service Teacher's Science Concepts Comprehension Based On Their Science Process Skill. *Jurnal Penelitian Pendidikan IPA*, *9*(2), 906–910. https://doi.org/10.29303/jppipa.v9i2.3241

Suharlan, L. S., Arsyad, M., & Palloan, P. (2023). The Influence of Problem Based Learning and Self Directed Learning Models on Students' Problem Solving Abilites. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 11386–11393. https://doi.org/10.29303/jppipa.v9i12.4730

Suhirman, S., & Prayogi, S. (2023). Overcoming challenges in STEM education: A literature review that leads to effective pedagogy in STEM learning. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 432–443. https://doi.org/10.29303/jppipa.v9i8.4715

Supriyadi, E., Dahlan, J. A., & Juandi, D. (2023). Publication trends from STEAM in education from scopus database: Bibliometric analysis. *Jurnal Penelitian Pendidikan IPA*, *9*(6), 104–111. https://doi.org/10.29303/jppipa.v9i6.3576

Suryanto, A., Saliman, S., & Sudrajat, S. (2023). The Weakness of Character Education in Indonesian Teenager. *Jurnal Penelitian Pendidikan IPA*, *9*(5), 3869–3874. https://doi.org/10.29303/jppipa.v9i5.3721

Susilawati, S., Doyan, A., Rokhmat, J., Gunawan, G., Gunada, I. W., & Hikmawati, H. (2023). Validation of PhET-Based Core Physics Teaching Materials to Improve Activities and Learning Outcomes of Physics Education Students. *Jurnal Penelitian Pendidikan IPA*, *9*(5), 2715–2719. https://doi.org/10.29303/jppipa.v9i5.3929