

Development of STEM-Based Learning “Car Balloons” to Support Pancasila Students Profiles

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ABSTRACT

The concept of an independent learning curriculum issued by the government aims to liberate education so that students can think and innovate freely. One way to support the independence of student education is to make adjustments in the learning process, especially in elementary schools. Therefore, this study develops learning on a STEM basis to support the profile of Pancasila students. One of the actions that can be taken is to develop learning on a STEM basis to support the profile of Pancasila students. The purpose of this learning development is an effort to support the concept of an independent curriculum. This study uses the ADDIE method, which has five stages: analyze, design, develop, implement, and evaluate. The results showed that STEM-based learning could support the profile of Pancasila students. The teaching modules developed are on valid criteria, with a score range of $4 \leq V < 5$. Likewise, the practicality of the module is a very practical criterion, with a score of 5. Student responses to STEM-based learning indicate that it can help support the achievement of the Pancasila student profile, namely critical reasoning, cooperation, and independence. In addition, the developed teaching modules can also help the learning process that is meaningful, fun, and interesting so that it can improve students' understanding as evidenced by the percentage of students' completeness that reaches 100% and is in very good criteria. Based on the study results, it can be concluded that the STEM-based learning module has met the valid, practical, and effective criteria for use in student learning in elementary schools.

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1. INTRODUCTION

Character education is a process of learning activities carried out to instill noble values character noble character based on religious teachings, customs, and Indonesian values in order to shape students' personalities so that they have dignity and characters that are in accordance with the noble values of the nation and religion (Rasyid, 2016). National Education places character education at the heart of providing education for students, which is used as the main step to facing the challenges of the 21st century. Strengthening student character is certainly involved in the process of preparing students' competitiveness with 21st-century skills, namely Competency 4C: Critical Thinking a Problem Solving (critical thinking and problem solving); Creativity (creativity); Communication Skills (the ability to communicate); and Ability to Work Collaboratively (the ability to work together or collaborate) (Septikasari & Frasandy, 2018). Furthermore, the Ministry of Education and Culture strengthens character education by creating a profile of Pancasila students.

The policy of creating a Pancasila student profile leads to learning with the aim of realizing Indonesian students who have the Pancasila personality and are able to apply or implement Pancasila values in everyday life. In accordance with the Vision and Mission of the Ministry of Education and Culture as stated in the Regulation of the Minister of Education and Culture Number 22 of 2020 concerning the Strategic Plan of the Ministry of Education and Culture for 2020-2024 is the embodiment of Indonesian students as lifelong students who have global competence and behave in accordance with the values Pancasila values which have the following six characteristics: (1) Faith, fear of God Almighty, and noble character; (2) Global diversity; (3) Working together; (4) Independent; (5) Critical reasoning; and (6) Creative (Kementerian Pendidikan Dan Kebudayaan, 2020).

One effort that can be made to realize the profile of Pancasila students is to take a class-based approach, namely character planting, by implementing character values into the subjects taught in schools. Regulation of the Ministry of Education and Culture Number 20 of 2018 article 6 paragraph 2 concerning Strengthening Character Education in Formal Education Units, class-based PPK is carried out by (1) integrating character values in the thematic or integrated learning activity process in subjects according to curriculum content, (2) plan class management and learning or mentoring methods according to the character of students, (3) evaluate learning or mentoring, and (4) develop local content curricula in accordance with the needs and characteristics of regions, educational units, and students. Further, Utomo (2016) explains that character education that is integrated into all subjects can provide a more meaningful experience for students because students can understand, internalize, and actualize it through the learning process so that these values can be absorbed naturally through daily activities. The strengthening of character education carried out in the classroom involves more student activities than using the lecture method and applying a broad-based curriculum that optimizes learning resources.

One approach that can be taken in learning activities that can involve students' activeness in learning and can be used as an effort to realize the character profile of Pancasila students in STEM (Science, Technology, Engineering, and Mathematics). STEM education is learning that combines several sciences such as science, technology, engineering, and mathematics which have an important role for students in developing creativity through problem-solving processes in everyday life. STEM learning can be seen from the asking stage, imagining stage, planning stage, creating stage, and improving stage; when students are able to carry out these stages, unconsciously, students are doing engineering in learning activities (Cunningham & Hester in Haryati et al., 2020).

Based on the results of observations, it was found that students' problem-solving abilities and critical thinking skills were low in the learning process. This is because the learning process is more focused on emphasizing the material rather than on applications related to everyday life. Therefore, students can solve problems and make decisions through critical thinking or fulfil their curiosity by working together through collaboration and communication. This is in line with the indicators of the Pancasila student profile, namely critical thinking, cooperation, and independence, which is where STEM learning shows students how the principles of science, technology, engineering, and mathematics

are combined to develop a product, process, a system that provides benefits for life. According to Wilson (in Hafni et al., 2020), critical thinking skills can affect students' potential directly by applying a series of information effectively so that they can decide on the best alternative solution in solving a problem such as processing big data. This is in line with the opinion (Morrison et al., 2015) that STEM-based learning can educate students to become critical thinkers.

The observations also show that the learning method used is still conventional, so the method has not been able to improve students' critical thinking skills. Therefore, in the learning process, it is necessary to use a STEM-based learning approach through project activities and group learning methods. It aims to improve student learning outcomes by sharing with friends, solving problems together, instilling an attitude of shared responsibility and developing social life in students. This is in line with Suarniati's opinion (in Insani et al., 2021) that one way to improve students' critical thinking skills is through the development of learning tools that can support learning success in determining students' critical thinking skills. Research in line with this opinion conducted by Asri (in Sulistyawati et al., 2021) states that STEM-based learning can improve the ability to think logically, innovatively, creatively, and problem-solving. Working together in teams can also increase interest in student learning; learning becomes more meaningful, helps students solve real-life problems, and supports future careers (Tseng et al. in Isro et al., 2021). According to Rivai et al. (in Prasadi et al., 2020), integrated education in STEM is the right approach to improving the quality of education. This is where the learning process in schools must be integrated with relevant technology so that the learning process can be carried out in this case, the community (Artotama in Prasadi et al., 2020) and students can relate it to real life (Morgot et al in Prasadi et al., 2020).

Furthermore, based on the study's results, researchers found several problems where teachers still did not know the real STEM learning and still needed a learning tool or device as a learning resource to understand learning techniques. Therefore, the researcher views that using STEM-based teaching modules for teachers and students in elementary schools can gain an adequate understanding. The learning module is mainly linked to the 2013 curriculum, which combines STEM-based learning and integrates the profile of Pancasila students as a collaboration in meeting skills in the 21st century (Nurjaman in Firdaus & Hamdu, 2020). The above considerations have inspired the development of a STEM-based teaching module so that teachers can use it practically. With this module, teachers get a new style to be a learning reference that will be applied (Rahmayanti in Firdaus & Hamdu, 2020).

STEM-based learning is considered learning that is able to integrate the skills needed by children. STEM education is a new learning innovation in the face of the times that have entered the industrial revolution 4.0. STEM is a composition that can form scientific thinking skills in children through the practice of comparing, classifying, sorting, and making patterns. Syamsiatin (in Sa'ida, 2021) said that the beginning of the creation of STEM was in the world of education, industry, and government in developed countries by requiring graduates to have the ability in the fields of Science, Technology, Engineering, and Mathematics to be able to develop scientific thinking in accordance with his profession. Philosophy integrates knowledge across disciplines, encouraging them to think in a rational and critical way. Therefore, this research focuses on developing learning that adapts and focuses on the material to be studied so that it can support the realization of the Pancasila student profile.

This research was conducted as an opportunity to develop teaching materials. In elementary schools, the learning content is not taught in an integrated manner but separately, although the lessons are based on THEMATIC. Elementary school teachers need to plan and implement learning into student activity so that students not only understand the material through explanations but can also understand it in real life through meaningful activities, such as learning using STEM. The goal of sustainable STEM-based learning can take place from an early age. So that it requires teachers to be able to design lessons be well informed about the benefits of STEM education, and be ready and committed to prepare, engage, and inspire their students (Kennedy & Odell in Vlasopoulou et al., 2020). From a theoretical point of view, according to Papert and Harel (in Miller, 2019) that learning is building a knowledge structure through progressive internalization of action, which often occurs in situations where students learn

through action. For example, in this study, students build and internalize their knowledge of several concepts such as science, mathematics, Indonesian language, IPS, SBdp, and PKN when they are involved with a learning experience in a learning activity, namely making balloon cars so that they can build and reconstruct their knowledge through 'To do'. This theoretical approach to learning helps researchers understand how students construct or deepen their knowledge and how this is expressed through the balloon car project. Students will be enthusiastic about learning by going through a project, including making works or tools. This can encourage students to be creative and critical. Therefore, learning by applying STEM can encourage students to design, develop and utilize technology, sharpen cognitive, manipulative, affective and apply knowledge (Permananasari in Efendi, 2018).

In the opinion of Capraro & Slough (in Asigigan & Samur, 2021), STEM project-based learning redesigns the teaching of empowered professionals with the skills needed to design learning experiences that maximize student potential. Also, through this research, the development of teaching modules helps students understand the concepts of learning materials. The selection of modules in learning is based on the advantages of the module. Modules are the most accessible media because they can be studied anywhere and anytime without using particular tools, convey learning messages that describe words, pictures and numbers, and increase student motivation. The learning load is divided more evenly. Teachers can find out which students are successful or not. In addition, according to Fatimah et al. (in Setyandaru et al., 2017), the advantage of module teaching materials is that modules can be used as independent teaching materials that improve students' ability to learn on their own.

2. METHODS

This type of research is ADDIE model development research (Branch, 2009). ADDIE is a fundamental process for developing or creating effective learning resource products. The ADDIE method becomes a process that serves as a guiding framework for complex situations, making it appropriate for developing educational products and other learning resources. ADDIE stands for Analyze, Design, Develop, Implement, and Evaluate, where these five terms are the stages in this development research. In the first analysis stage, identification of possible causes of the condition gap in the field is carried out; in the second stage, the design is carried out to verify the desired conditions and appropriate test methods and produce an initial draft. Then, in the third stage of development, validation of learning resources is carried out, namely the initial draft produced in the previous stage. The fourth stage of implementation is the preparation of the learning environment. It involves students, and the last stage, evaluation, is an assessment of the quality of the product and the learning process, both before and after implementation.

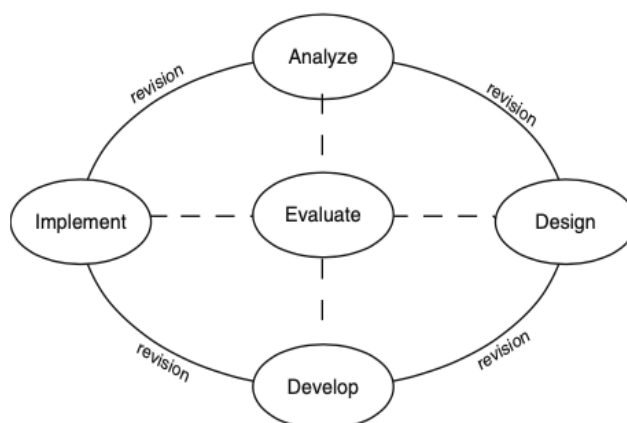


Figure 1. ADDIE Model Stages

The research was conducted at SDN 41 Tarakan City using 28 students in grade 4B in the even semester of the 2021/2022 academic year. This research is intended to develop a STEM-based teaching

module as a research product. In the study, the data collection techniques used were: 1) Test technique, the type of test used was a pretest to determine students' initial abilities by using a diagnostic assessment and a posttest to determine the effectiveness of using the module in learning; 2) Non-test technique, this technique uses a questionnaire, where the questionnaire is used at the beginning of the study to determine student learning styles and at the end of the study to determine the practicality of the module, and this technique is carried out by testing the validity, practicality and student responses to the learning module. , 3) Observation and Interview Techniques, this technique aims to obtain data and information related to the problems of implementing learning in grade 4-B students, 4) Documentation techniques in this technique can be done by recording and documenting various activities and things important during the study.

The instruments used in this study were questionnaires or questionnaires, diagnostic assessment sheets, test sheets, media validation sheets, student response sheets, and practicality validation sheets. Then, the data analysis techniques used in this research are validity, practicality, the effectiveness of learning modules, and analysis of student responses.

3. FINDINGS AND DISCUSSION

A. Analysis Stage

At the analysis stage, it is carried out to obtain data and information about the problems found by students and find out what is needed to overcome these problems. At this stage of analysis, it is divided into three general analyzes, namely: 1) Performance Analysis, data obtained that students have difficulty mastering and understanding the material optimally in the learning process, 2) Needs analysis, obtained information that teaching materials are only from student handbooks that were resulting in their understanding of the material being less trained and well absorbed because the only theory is given without any practice, 3) Curriculum analysis, information was obtained that SDN 041 Tarakan uses the 2013 Curriculum (K-13) which in this curriculum students no longer use textbooks but using a thematic book in which there are several related lesson content, then Basic Competencies (KD) in the form of scope and sequence which are grouped into four Core Competencies (KI), namely: Spiritual Attitudes, Social Attitudes, Knowledge, and Skills.

B. Design Stage

Based on the analysis phase results, we want to develop a STEM-based learning module. The module design is made more colorful and illustrated in order to attract students' attention because this teaching module is intended for fourth-grade elementary school students. The reference source used in developing the module teaching materials refers to the Theme 9 material used based on Basic Competencies, Competency Standards, and Learning Objectives per the 2013 curriculum. This teaching module is designed to integrate STEM (Science, Technology, Engineering, Mathematics) learning which is more advanced. Focused on Science and Mathematics, as well as three profiles of Pancasila students, namely critical reasoning, independence, and cooperation. In this teaching module, there are learning methods for each activity, sequence of activities, material for understanding concepts, student worksheets, critical thinking sheets, and "Balloon Car" practicum to support student understanding. The student worksheets in the module are designed so that students are actively involved in learning activities, from analyzing problems and designing experiments to presenting them. Active student involvement in learning activities is one way to increase enthusiasm that encourages the achievement of learning objectives (Jablon & Wilkinson in Prabowo et al., 2016). Then the contents of the teaching module are divided into three activities, namely 1) Activity 1 contains science, social studies, SBdP subjects, 2) Activity 2 contains PKN, Indonesian, and Mathematics subjects, 3) Activity 3 contains the "Balloon Car" practicum and daily tests.

C. Development Stage

The follow-up to the design result that has been made is to develop the learning media into learning media that are ready to be used by users. The users here are targeted teachers and fourth-grade elementary school students. The development of this learning media is made from Microsoft Office applications using standard Indonesian so that students easily understand it. It is making the design of this learning media using the PhotoShop application. The material is taken from the book TEMA 9 (Jamrud & Bupetik) Class IV.

Before this STEM-based teaching module was used, this teaching module was validated by testing the teaching module to the validator of the display aspect media expert as well as the material aspect media expert. The validator is one of the lecturers in the Faculty of Teacher Training and Education, University of Borneo Tarakan. From the validation results of the media expert on the display aspect and the media expert on the material aspect. The results of media expert validation in terms of appearance and material can be seen in Table 1. below:

Table 1.
Media Expert Validation Results Display & Material Aspects

Aspect	Average	Criteria
Presentation	4,1	Valid
Appearance	4,2	Valid
Compability	4,1	Valid

Based on the validation result by media experts on the aspect of display and material, it was found that each indicator got a value of 4.1 and 4.2 of the maximum value of 5. Following the criteria of validation assessment by Anggoro & Yunianta (in Widyatama & Pratama, 2022) that the range of scores $4 \leq V < 5$ is a valid criteria. The validity results have met the criteria as expressed by Hobri (in Setyandaru et al., 2017) that every aspect or indicator measured gets an assessment of 3 so that it passes the development test and is suitable for use in learning. Furthermore, Arikunto (in Irmawati et al., 2021) says that learning media is said to be valid if the results match the criteria. The validation results indicate that the developed module has met the components of suitable teaching materials contained in the 2018 Minister of Education and Culture. In addition, the developed teaching module can be said to be valid if the results are declared valid by the validating expert (Sawitri in S.Sirate & Ramadhana, 2017). This makes STEM-based teaching modules valid to be implemented in the field without revision for media and materials.

Then, the STEM-based teaching module was tested on the media practicality validator. The validator is a Class IV B guardian of SDN 041 Tarakan. The results of practical validation of the development of teaching modules can be seen in Table 2. below:

Table 2.
Practical Validation Results on the Development of Teaching Modules

Aspect	Average	Criteria
Effective	5	Very Practical
Interactive	5	Very Practical
Efficient	5	Very Practical
Creative	5	Very Practical

From the results of practicality validation, it was found that each indicator has a very practical criteria, with each worth 5 of the maximum value of 5. The criteria follows the validation assessment criteria table by Anggoro & Yunianta (in Widyatama & Pratama, 2022) that the score range is $V = 5$ is a very practical criteria. The validity results have met the criteria as expressed by Hobri (in Setyandaru et al., 2017) that every aspect or indicator measured gets an assessment of 3 so that it passes the development test and is suitable for use in learning. This makes STEM-based teaching modules very practical to implement in the field.

D. Implement Stage

After the teaching module is tested for validation, the teaching module is ready to be implemented for students. The implementation was carried out on 28 students from class IV B SDN 041 Tarakan. However, the reality in the field is that only 14 students are working on the pretest, media testing, posttest, and filling out student response sheets. This happens because the implementation phase is offline, where students enter school with a hybrid system (offline and online learning). Students are divided into two groups and have a session scheduled to attend school. Furthermore, student response data is taken to determine student responses to the use of modules that have been developed in learning by providing an assessment sheet in the form of student response questionnaires. Table 3 shows the results of students' responses to STEM-based learning.

Table 3.

Results of Student Responses to STEM-Based Learning		
Aspect	Average	Criteria
Usefulness	5	Very Good
Convenience	5	Very Good
Satisfaction	5	Very Good

Based on Table 3, the average indicator value is five from a maximum score of 5 in the very good criteria. These data indicate that students strongly agree that STEM-based teaching modules can be feasible and have a positive influence on learning activities on Theme 9. This follows what was stated by Trianto (in Setyandaru et al., 2017) stated: a positive learning response if the number of positive categories with the number of students 50% of all students. This statement is also in line with Nugaraha et al. (in Setyandaru et al., 2017), which says that students' positive responses can be used as a reference that students agree with the materials developed to be used in learning activities. So that the positive response given by students to the teaching module can improve their understanding of concepts in students; this is in line with the research conducted by Kartikasari et al. (in Setyandaru et al., 2017), which shows that the results of student responses can affect student understanding. This can also be proven by the achievement of the Pancasila student profile in learning following the indicators of the Pancasila student profile contained in the Renstra of the Ministry of Education and Culture (Juliani & Bastian, 2021), namely critical reasoning, cooperation, and independence. Critical reasoning in learning is seen in the ability of students to obtain and process information, analyze information, provide conclusions and follow the evaluation of learning, as well as students' ability to re-explain the material that has been taught. This statement is in line with the opinion of Purnomo and Pratiwi (in Desi Indriyani & Yanti Fitria, 2019) that students who think critically are Pancasila students who are objectively able to process information both qualitatively and quantitatively and can relate, analyze, evaluate, and can conclude various information obtained (Desi Indriyani, Yanti Fitria, 2019). Then, the profile of Pancasila students working together can be proven by the ability of students to carry out activities together, where students study in groups to complete projects designed in STEM-based learning modules. In addition, the profile of Pancasila students in terms of independence can be proven by the awareness of students in completing their respective tasks on projects that have been designed in STEM-based learning modules. This is following the Ministry of Education and Culture, Research and Technology that the cultivation of the Pancasila student profile can be done by integrating it into learning, namely the implementation of the Pancasila student profile project. This statement is also in line with the opinion of Suryadien et al. (in Desi Indriyani & Yanti Fitria, 2019) that project learning can provide opportunities for students to get hands-on experience so that through this experience, the essential competencies and skills that students have learned from various disciplines have been integrated and the learning structure becomes more flexible and flexible. independence (Desi Indriyani, Yanti Fitria, 2019). Therefore, if the student's response to the teaching module is very good, then the teaching module helps the learning process that is meaningful, fun, and interesting to improve student understanding.

After the teaching module is implemented, its effectiveness in learning is seen. The effectiveness of learning is related to the quality of learning, which can be seen to what extent the learning objectives can be achieved. The effectiveness of the teaching module can be seen from the posttest results. As for the results of the posttest, it is known that as many as 14 of the 14 students have reached the KKM (Maximum Completeness Criteria) with a percentage of completeness reaching 100% with very good criteria, following the criteria for assessing academic skills (Suastika, I Ketut & Rahmawati, 2019). These conditions indicate that the teaching module is practical for use in learning. In addition, Suastika, I Ketut & Rahmawati (2019) stated that using teaching modules in learning activities could show that learning activities are more well planned, complete, independent, and with clear learning outcomes.

E. Evaluate Stage

This stage is an assessment stage of the quality of the product and the learning process, both before and after implementation. This evaluation stage can be seen from the results of the Pretest and Posttest so that it can be seen that there are differences before and after the development of STEM-based teaching modules in learning. Before the teaching module's development, the classroom learning process was only in the form of presenting material without being combined with other teaching methods and materials. The results of the pretest are in the form of a diagnostic assessment which shows that the average score of students is below the KKM. Then, after the development of STEM-based teaching modules in learning, students' understanding of material concepts has begun to increase. This is supported by the results of the post-test in the form of daily tests, which have been described above in the module effectiveness section that the percentage of students' completeness reaches 100% with very good criteria. Not only that, but students' responses to the development of teaching modules also gave a positive response. This is evidenced by the data on student responses in Table 3. The average value of each indicator given by students is 5 out of a maximum score of 5 with a very good criteria. These data indicate that students strongly agree that STEM-based teaching modules are used in learning activities. With the difference in results before and after the development of STEM-based teaching modules in learning, it shows that there is a significant increase or positive influence on student learning outcomes after using teaching modules and the application of STEM-based learning from several research results that have been shown to increase learning activities and critical thinking skills. students (Islamyah, Yasa, & Rachmawati in Irmawati et al., 2021). This is supported by the results of Pummawan's research (in Rosa, 2015) that the use of modules in learning is a means to develop students' cognitive abilities; mainly, if the learning modules are used appropriately and adequately, it will provide significant benefits for teachers and students (Emda in Irmawati et al., 2021).

4. CONCLUSION

The STEM-based learning module developed was declared valid based on the validation results by media experts with a validation score range of $4 \leq V < 5$, which is a valid criteria. The value of the practicality of the module based on the results of practicality validation by the teacher gets a score range of $V = 5$, which is a very practical criteria. The results of student responses to STEM-based learning modules can help a meaningful, fun, and exciting learning process to improve student understanding. This condition is evident from student learning outcomes after using the STEM learning module, where it is supported by the post-test results in the form of daily tests, which have been described above in the module effectiveness section that the percentage of student completeness reaches 100% with very good criteria. This can also be proven by the achievement of the Pancasila student profile in learning, namely critical reasoning, cooperation, and independence. Critical reasoning in learning is seen in the ability of students to obtain and process information, analyze information, provide conclusions and follow the evaluation of learning, as well as students' ability to re-explain the material that has been taught. Then, the profile of Pancasila students working together

can be proven by the ability of students to carry out activities together, where students study in groups to complete projects designed in STEM-based learning modules. In addition, the profile of Pancasila students in terms of independence can be proven by the awareness of students in completing their respective tasks on projects that have been designed in STEM-based learning modules. Based on these data, it can be concluded that the STEM-based learning module has met the valid, practical and effective criteria for use and has a considerable influence on student learning outcomes, so it is very feasible to use.

REFERENCES

- Asigigan, S. I., & Samur, Y. (2021). The effect of gamified stem practices on students' intrinsic motivation, critical thinking disposition levels, and perception of problem-solving skills. *International Journal of Education in Mathematics, Science and Technology*, 9(2), 332–352. <https://doi.org/10.46328/IJEMST.1157>
- Branch, R. M. (2009). *Instructional Design*: Springer.
- Desi Indriyani, Yanti Fitria, I. (2019). Jurnal basicedu. *Jurnal Basicedu*, 5(3), 1683–1688.
- Efendi, A. (2018). *Indonesian Journal of Primary Education Pembelajaran Stem Berbasis Outbound Permainan Tradisional*. 2(2), 40–47.
- Firdaus, S., & Hamdu, G. (2020). Pengembangan Mobile Learning Video Pembelajaran Berbasis STEM (Science, Technology, Engineering And Mathematics) Di Sekolah Dasar. *JINOTEP (Jurnal Inovasi Dan Teknologi Pembelajaran): Kajian Dan Riset Dalam Teknologi Pembelajaran*, 7(2), 66–75. <https://doi.org/10.17977/um031v7i22020p066>
- Hafni, R. N., Herman, T., Nurlaelah, E., & Mustikasari, L. (2020). The importance of science, technology, engineering, and mathematics (STEM) education to enhance students' critical thinking skill in facing the industry 4.0. *Journal of Physics: Conference Series*, 1521(4), 0–7. <https://doi.org/10.1088/1742-6596/1521/4/042040>
- Haryati, T., Lidinillah, D. A. M., & Karlimah, K. (2020). Pengembangan Desain Pembelajaran STEM dalam Kurikulum 2013 di Sekolah Dasar: Suatu Analisis dan Eksplorasi. *DIDAKTIKA: Jurnal Pendidikan Sekolah Dasar*, 3(2), 71–78. <https://doi.org/10.21831/didaktika.v3i2.33303>
- Insani, K., Hobri, Prihandoko, A. C., Sa'id, I. A., & Safik, M. (2021). Developing of learning tools based on science, technology, engineering, and mathematics (STEM) based on learning community to improve critical thinking ability in class X student's arithmetic sequences and arithmetic materials. *Journal of Physics: Conference Series*, 1839(1). <https://doi.org/10.1088/1742-6596/1839/1/012020>
- Irmawati, I., Syahmani, S., & Yulinda, R. (2021). Pengembangan Modul IPA Pada Materi Sistem Organ Dan Organisme Berbasis STEM-Inkuiri untuk Meningkatkan Literasi Sains. *Journal of Mathematics Science and Computer Education*, 1(2), 64. <https://doi.org/10.20527/jmscedu.v1i2.4048>
- Isro, A. L., Anggraito, Y. U., Bintari, S. H., & Semarang, U. N. (2021). Description of students' critical thinking skills in integrated PJBL STEM learning environmental change material. *Journal of Innovative Science Education*, 10(37), 237–243. <https://journal.unnes.ac.id/sju/index.php/jise/article/download/43920/17871>
- Juliani, A. J., & Bastian, A. (2021). *Pendidikan Karakter Sebagai Upaya Wujudkan Pelajar Pancasila*. 257–265.
- Kementerian Pendidikan Dan Kebudayaan. (2020). Implementasi Profil Pelajar Pancasila. <https://cerdasberkarakter.kemdikbud.go.id>, 1–8. [chrome-extension://efaidnbmnnnibpajpcglclefindmkaj/https://cerdasberkarakter.kemdikbud.go.id/sahabatkarakter/kegiatan/a9151c70-96fe-4594-aa38-e40e5d7ad237.pdf](https://cerdasberkarakter.kemdikbud.go.id/sahabatkarakter/kegiatan/a9151c70-96fe-4594-aa38-e40e5d7ad237.pdf)
- Miller, J. (2019). STEM education in the primary years to support mathematical thinking: using coding to identify mathematical structures and patterns. *ZDM - Mathematics Education*, 51(6), 915–927. <https://doi.org/10.1007/s11858-019-01096-y>
- Morrison, J., Roth McDuffie, A., & French, B. (2015). Identifying Key Components of Teaching and

- Learning in a STEM School. *School Science and Mathematics*, 115(5), 244–255. <https://doi.org/10.1111/ssm.12126>
- Prabowo, C. A., Ibrohim, & Saptasari, M. (2016). Pengembangan Modul Pembelajaran Inkuiri Berbasis Laboratorium Virtual. *Jurnal Pendidikan - Teori, Penelitian, Dan Pengembangan*, 1(6), 1090–1097. <https://doi.org/10.17977/jp.v1i6.6422>
- Prasadi, A. H., Wiyanto, W., & Suharini, E. (2020). The Implementation of Student Worksheet Based on STEM (Science, Technology, Engineering, Mathematics) and Local Wisdom to Improve of Critical Thinking Ability of Fourth Grade Students. *Journal of Primary Education*, 9(3), 227–237. <https://doi.org/10.15294/jpe.v9i3.37712>
- RASYID, H. A. (2016). Implementasi Pendidikan Karakter dalam Pembelajaran IPS di Madrasah Aliyah. *SOCIA: Jurnal Ilmu-Ilmu Sosial*, 13(1). <https://doi.org/10.21831/socia.v13i1.9904>
- Rosa, F. O. (2015). Pengembangan Modul Pembelajaran Ipa Smp Pada Materi Tekanan Berbasis Keterampilan Proses Sains. *Jurnal Pendidikan Fisika*, 3(1). <https://doi.org/10.24127/jpf.v3i1.21>
- S.Sirate, S. F., & Ramadhana, R. (2017). Pengembangan Modul Pembelajaran Berbasis Keterampilan Literasi. *Inspiratif Pendidikan*, 6(2), 316. <https://doi.org/10.24252/ip.v6i2.5763>
- Sa'ida, N. (2021). Pemahaman Konsep Geometri Anak Usia Dini pada Pembelajaran Berbasis STEAM. *Jurnal PG-PAUD Trunojoyo: Jurnal Pendidikan Dan Pembelajaran Anak Usia Dini*, 8(1), 1–7. <https://doi.org/10.21107/pgpaudtrunojoyo.v8i1.9782>
- Septikasari, R., & Frasandy, R. (2018). Keterampilan 4C Abad 21 Dalam Pembelajaran Pendidikan Dasar. *Jurnal Tarbiyah Al Awlad*, VIII, 107–117.
- Setyandaru, T. A., Wahyuni, S., & Putra, P. D. A. (2017). Pengembangan Modul Pembelajaran Berbasis Multirepresentasi Pada Pembelajaran Fisika Di Sma/Ma. *Jurnal Pembelajaran Fisika*, 6(3), 218–224.
- Suastika, I Ketut & Rahmawati, A. (2019). *P Pengembangan M Odul P Embelajaran M Aematika Dengan P Endekatan K Ontekstual*. September, 58–61.
- Sulistyawati, E., Faizah, L., Nisa, I., & Putra, I. G. (2021). Pengembangan Media Pembelajaran Berbasis Stem Rumah Hidrolik Di Tinjau Dari Hasil Belajar Dan Respon Siswa Terhadap Matematika. *Factor M*, 3(2), 125–138. <https://doi.org/10.30762/factor-m.v3i2.2611>
- Utomo, E. P. (2016). Internalisasi Nilai Karakter pembelajaran IPS. *Metafora: Education, Social Sciences and Humanities Journal*, 2(2), 91–104. <https://journal.unesa.ac.id/index.php/metafora/article/view/10651>
- Vlasopoulou, M., Kalogiannakis, M., & Sifaki, E. (2020). *Investigating Teachers' Attitudes and Behavioral Intentions for the Impending Integration of STEM Education in Primary Schools*. 235–256. <https://doi.org/10.4018/978-1-7998-6717-3.ch009>
- Widyatama, A., & Pratama, F. W. (2022). *Pengembangan Mobile Learning PINTHIR Berbasis Android sebagai Sumber Belajar dan Sarana Mengerjakan Soal Trigonometri SMA Mosharafa : Jurnal Pendidikan Matematika penggabungan antara mobile serta e- Mosharafa : Jurnal Pendidikan Matematika*. 11, 1–12.