JCP Jurnal Cakrawala Pendas
Vol. 11 No. 2, April 2025
DOI: http://dx.doi.org/10.31949/jcp.v11i2.12910
p-ISSN: 2442-7470
e-ISSN: 2579-4442

DEVELOPMENT OF STEM EDP-BASED SCIENTIFIC ATTITUDE ASSESSMENT INSTRUMENT IN ELEMENTARY SCHOOL SCIENCE LEARNING

Nabila Alisyia Rahman[1*], Din Azwar Uswatun[2], Astri Sutisnawati[3]
[1,2,3]Universitas Muhammadiyah Sukabumi
[1]nabilaalisyiarahman@gmail.com

Abstract
The purpose of this study was to determine the feasibility of the scientific attitude assessment instrument based on the STEM approach with the EDP model in elementary school science learning. This study uses the research and development method. The method used in this development research is based on the Borg & Gall (2003) development model. The trial subjects were grade V Al-Khawarizmi V Al-Jazari elementary school students. This study used instruments in the form of questionnaires and observation sheets. The overall validation results from experts reached a percentage of 80.5% with the category "Feasible" and the results from practitioners showed 86.11% with the category "very practical". After the feasibility and practical test of scientific attitude product development, there were 15 valid questions and 0.811 which were stated as very reliable and the observation sheet assessed by the educator showed validity and reliability which showed 0.928. From the results of the needs analysis, the principle of developing a scientific attitude assessment instrument based on the STEM approach with the EDP model in science learning which not only focuses on science learning but the STEM approach that combines four fields of science, namely (Science, Technology, Engineering and Mathematics) this approach involves students in solving real problems, thus encouraging curiosity, objectivity, and cooperation. By using the EDP model, students grow their involvement through the stages of observation, design, testing, and evaluation, which triggers a careful attitude, and critical thinking.
Keywords: *Instruments; Assessment Scientific Attitude; STEM EDP; Elementary School*

Abstrak
Tujuan penelitian ini adalah untuk mengetahui kelayakan instrumen penilaian sikap ilmiah berbasis pendekatan STEM dengan model EDP dalam pembelajaran IPA sekolah dasar. Penelitian ini menggunakan metode penelitian pengembangan atau *Research and Development*. Metode yang digunakan pada penelitian pengembangan ini didasarkan pada model pengembangan Borg & Gall (2003). Subjek uji coba peserta didik kelas V Al- Khawarizmi V Al- Jazari sekolah dasar. Penelitian ini menggunakan dengan memanfaatkan instrumen berupa angket dan lembar observasi. Hasil validasi secara keseluruhan dari ahli mencapai presentase 80,5% dengan kategori "Layak" dan hasil dari praktisi menunjukkan 86,11% dengan kategori "sangat praktis". Setelah di uji kelayakan dan praktis pengembangan produk sikap ilmiah terdapat 15 soal yang valid dan 0,811 yang dinyatakan sangat reliabel dan lembar observasi yang dinilai oleh pendidik menunjukkan valid dan reliabilitas yang menunjukkan 0,928 Dari hasil analisis kebutuhan, maka prinsip pengembangan instrumen penilaian sikap ilmiah berbasis pendekatan STEM dengan model EDP dalam pembelajaran IPA yang tidak hanya fokus kedalam pembelajaran IPA saja tetapi pendekatan STEM yang memadukan empat bidang ilmu yaitu (Science, Technology, Engineering and Mathematics) pendekatan ini melibatkan peserta didik dalam pemecahan masalah nyata, sehingga mendorong rasa ingin tahu, objektivitas, dan kerja sama. Dengan menggunakan model EDP peserta didik menumbuhkan keterlibatan melalui tahapan observasi, perancangan, pengujian, dan evaluasi, yang memicu sikap teliti, serta berpikir kritis.
Kata Kunci: Instrumen, penilaian sikap ilmiah; STEM EDP; Sekolah Dasar

Received	: 2025-01-23	Approved	: 2025-04-17
Revised	: 2025-04-14	Published	: 2025-04-30

Introduction

Assessment is a systematic process for collecting and analyzing data related to student learning achievement.(Kuntarto & Gustina, 2019). Assessment in the learning process is the key to understanding this. Before starting learning, teachers should have an initial picture of the students they will teach. Thus, teachers can design learning plans by choosing media, methods and processes that are appropriate to the characteristics of the students they teach. According to Hastuti & Marzuki (2021), assessment can be interpreted as a process that includes measurement and non-measurement to obtain data on the characteristics of students according to predetermined rules. The success of a learning process can be measured by achieving predetermined learning objectives. To determine the level of achievement, it is necessary to carry out assessment and evaluation of student learning outcomes. In this context, teachers play a role in measuring the extent to which students have mastered the material that has been studied according to the objectives that have been set. Therefore, prospective teachers need to be equipped with an understanding of evaluation as a science that supports the implementation of their duties, namely assessing student learning outcomes.(Sole & Anggraeni, 2017).

Assessment of attitude aspects is used as one of the important elements in evaluation in elementary schools to strengthen the development of student character. This is especially relevant because 21st century education emphasizes the importance of the attitude dimension.(Amelia & Hamdu, 2022).According to Magdalena et al., (2020)Effective science learning is not only focused on understanding scientific attitudes that will support students' learning success in various fields. Students who have good scientific attitudes will be more sensitive to their surroundings. Students' academic achievement is always the only focus of teacher assessment while the affective aspect is often ignored because the tools to be used are written. Psychomotor aspects, especially affective aspects, rarely get attention from teachers. As a result, they only master the theory without having practical skills or the ability to apply the knowledge they learn.

Sole & Anggraeni (2017) bopinionThe lack of learning and evaluation in this affective aspect has an impact on the decline in morals which ultimately affects the morals of the nation as a whole. Therefore, 5 indicators of STEM-based scientific attitude assessment through the Engineering Design Process (EDP) model in science learning at the elementary school level are very important. The STEM approach is centered on students who combine theory and practice and facilitate the development of scientific attitude indicators. This approach not only focuses on science learning, but also combines it with technology, engineering, mathematics. Through the application of the EDP model, students are expected to be able to solve problems with concrete solutions developed through structured steps.

The implementation of the STEM (Science, Technology, Engineering and Mathematics) approach can be improved by planning technology learning activities such as the Engineering Design Process so that with the EDP students will gain comprehensive knowledge (Song et al., 2016). This means that students will apply more STEM knowledge and competencies in solving problems (Lin et al., 2021). In addition, many studies have shown that through the Engineering Design Process (EDP) can improve learning in STEM (Lin et al., 2021). Many teachers have limited understanding of the STEM approach with the EDP model integration, which results in less than optimal learning. In addition, time management is also an obstacle, where teachers often have difficulty managing time between planning and implementing learning, resulting in a mismatch between the learning plan and its implementation.In achieving learning that fosters a scientific attitude, namely through the STEM approach EDP model.

Jurnal Cakrawala Pendas Vol. 11, No. 2, April 2025, pp. 453-465

The STEM (Science, Technology, Engineering and Mathematics) approach is an educational method that combines four main fields, namely science, technology, engineering and mathematics. This method focuses on the application of knowledge in the four to solve challenges in everyday life. Learning in the fields of science, technology, engineering, mathematics or often referred to as STEM is the center of attention not only for teachers in schools but also for all stakeholders (Widiastuti & Wawan Budiyanto, 2022). This approach is a problem-solving strategy applied in STEM-based education as well as in real-world engineering practice. EDP is used to encourage a problem-solving learning environment that encourages students to imagine solutions to design challenges, gather relevant information, and solve real-world problems through the engineering design process. The EDP process is carried out repeatedly according to needs, so that students can make improvements to find new designs and arrive at the right solution (Putra et al. 2023). Engineering Design Process (EDP) learning encourages students to learn from failure so that students have the ability to create innovative solutions in facing challenges according to the concepts that have been understood. In engineering design process (EDP) learning, teachers no longer control learning but are only tasked with monitoring and guiding students in the problem-solving process. Based on a preliminary study, it was found that teachers are still not familiar with the STEM approach in depth. To overcome this, this study proposes an innovative approach, namely the STEM EDP model approach, which is expected to be a more effective alternative. Therefore, researchers conducted a development to test the feasibility of using a scientific attitude assessment instrument based on STEM-EDP. Although the STEM-EDP (Engineering Design Process) approach is a global concept, this approach has strong relevance to the direction of education policy in Indonesia, especially in the implementation of the Merdeka Curriculum. The Merdeka Curriculum emphasizes the importance of student-centered learning through a project-based and inquiry-based approach, as well as strengthening the Pancasila Student Profile. Values such as creativity, critical thinking, independence, and mutual cooperation are very much in line with the characteristics of the engineering process developed in STEM-EDP.

Assessment of scientific attitudes is an important part of science learning in elementary school. Scientific attitudes such as curiosity, openness to data, perseverance, and objectivity need to be developed early on so that students not only understand scientific concepts but also internalize scientific thinking. This is in line with the goals of national education which not only emphasize cognitive aspects, but also affective and psychomotor. However, in the context of learning in Indonesia, many teachers still face obstacles in assessing scientific attitudes authentically due to the limited assessment instruments that are valid and practical to use in the classroom. Therefore, the development of a scientific attitude assessment instrument based on STEM-EDP is a strategic effort to answer real needs in the field. This instrument is expected to be able to provide a more complete picture of the development of students' scientific attitudes in science learning in elementary schools.

Research Methods

This research is a development research or Research and Development. The method used in this development research is based on the Borg & Gall (2003) development model which defines that research and development in education is a process to develop and validate products. This research uses instruments in the form of questionnaires and observation sheets. Data collection using questionnaires and observation sheets. Data on the feasibility of the scientific attitude assessment instrument based on the STEM approach with the EDP model were analyzed using a 4-scale score conversion. This research was conducted by developing a scientific attitude assessment instrument systematically. These steps are (1) Research and Data Collection, (2) Planning Stage, (3) Product Development (4) Initial Field Test, (5) Product Revision, (6) Main Field Test, (7) Dissemination and Implementation. In this study, the research instruments used were the scientific attitude questionnaire validity assessment sheet to measure the validity of the scientific attitude questionnaire and the scientific attitude questionnaire practicality assessment sheet measured with a Likert scale questionnaire sheet containing material, construction and language. And to measure the validity and reliability of the scientific attitude questionnaire and observation sheet using SPSS 30.

Step (1) is research and information gathering. This information gathering is done by studying literature to examine theories related to scientific attitudes in science learning and developing instruments. Step (2) at the planning stage, the researcher carries out several activities including: a) creating a Phase C Learning Module Topic B Electrical Energy Material, b) creating a title in the content section containing a table of contents, grid, instrument form and instrument scoring guidelines. c) creating a product feasibility instrument using a 4-point scale questionnaire, at this stage the preparation of the assessment instrument is given to experts and practitioners. Step (3) Product Development At the initial product development stage, namely in the form of a scientific attitude assessment instrument in electrical energy learning based on the STEM approach with the EDP model that has gone through a valid process and signed that the product is suitable for use in the field. Step (4) Initial Field Test, an initial field test conducted in class V Al-Khawarizmi consisting of 10 students randomly and who did not yet understand the STEM EDP approach, which aims to evaluate the extent to which the feasibility of the scientific attitude assessment instrument can be used based on the STEM approach with the EDP model in science learning in elementary schools.Step (5) Revising the Product, based on the results of the initial field test, the researcher revised the product to be tested in the main field. Step (6) Main Field Test, the main field test conducted in class V Al-Jazari, namely 20 students, aims to determine the extent to which students understand STEM EDP-based learning and to test the feasibility of the product development of scientific attitude assessment instruments. Step (7) Dissemination and implementation, at this stage the product is disseminated via the STEM EDP edu website http://www.edustemedp.site.

Data collection used in this study were questionnaires and observation sheets. The questionnaire sheets were distributed to students after doing engineering practice and the observation sheets were carried out during the learning process and product/engineering presentations assessed by the teacher through observation sheets. There are five indicators consisting of curiosity, critical thinking, responsibility, cooperation and objective. Observations were analyzed through 4 scales, namely very good, good, sufficient and need improvement if students' curiosity, critical thinking, and objective are very good but during the learning process their responsibility and cooperation are less meaningful getting good or sufficient grades.The data analysis technique in this development research uses and quantitative data analysis.

Quantitative data in this study were obtained from changing qualitative data into quantitative data using a Likert scale that produces scoring for each answer. The qualitative data obtained were then changed into quantitative data using the Likert Scale. The Likert Scale has a gradation from very positive to very negative which can be realized in the form of words. The level of value weight used as a measurement scale is 4, 3, 2, 1.

Table 1. Likert Scale Questionnaire Answers

Number	Criteria
4	Very good
3	Good
2	Pretty good
1	Not good

According to Yuliandriati et al., (2019), to manage quantitative data from all expert validation questionnaire indicators, the following formula is used.

$$P=\frac{Skor\ yang\ diperoleh}{skor\ maksimum}x100$$

Description: P = percentage

The results of the questionnaire or questionnaire of the feasibility of the results from the experts become qualitative data from the results then interpret the validity value. In order to determine whether the product is valid or invalid and feasible or not feasible to use. And will be commented on by experts and students.

Table 2. Eligibility Criteria

Percentation	Classification
81%-100%	Very Worth It
61%-80%	Worthy
50%-60%	Not worthy
0%-50%	Not feasible

(Aeni dkk 2024).

The questions that have been declared valid are then tested for reliability. The researcher uses Cronbach Alpha to test the reliability of the questions and is calculated using SPSS 30. The reliability test uses the Cronbach Alpha formula as follows (Putra 2021).

$$\boldsymbol{r_{11}}=\left(\frac{k}{k-1}\right)\left(1-\frac{\Sigma\sigma^2}{\sigma_t^2}\right)$$

Information :
R_{11} = Reliabilitas Instrumen
K= Number of Questions or Issues
$\Sigma\sigma^{2=}$ *Jumlah varian butir*
$\sigma\frac{2}{T}$= Total Variance

Table 3. Interpretation of Cronbach Alpha Value Size

Cronbach Alpha Value	Interpretation
0.0 – 0.20	Less Reliable
0.21 – 0.40	Somewhat Reliable
0.41 – 0.60	Quite Reliable
0.61 – 0.80	Reliable
0.81 – 1.00	Very Reliable

Results and Discussion

The first stage, namely this research began with a preliminary study involving a review of various literature related to scientific attitudes and the implementation of an in-depth study of scientific attitude assessment based on the STEM approach with the EDP model in science learning at the elementary school level. To obtain data on the implementation of scientific attitude assessment in elementary schools in Sukabumi City, researchers conducted initial observations and interviews. In the initial observations and interviews, it can be concluded that students are generally enthusiastic about the experimental material, although some are less interested and need to be reminded. Students are more interested if learning is carried out with a variety of methods and not just lectures. In group activities, most students can work together, but there are still challenges due to differences in character. When faced with difficulties in experiments, most students show enthusiasm to try again and do not hesitate to ask the teacher, especially on materials such as "Light". Students show diverse attitudes in accepting friends' opinions; some are open, some reject. Their ability to evaluate work results has been assisted by reference values based on attitude indicators. Regarding the use of tools and materials, students often need to be reminded to be more responsible. Only a small number are able to think creatively or convey alternative ideas. However, they are used to following the rules that have been agreed upon together since the beginning of learning, including during practicums and group assignments. In general, experimental learning is more popular, and students show the potential to develop in an interesting and interactive learning environment. The instrument used to obtain initial data, researchers conducted several questions related to scientific attitudes in science learning in elementary schools. The dominant factor put forward by teachers was not knowing the indicators of scientific attitudes and only focusing on the cognitive domain. It was also explained that teachers did not yet know the STEM (Science, Technology, Engineering and Mathematics) approach with the EDP (Engineering Design Process) model.

The second stage is planning, the researcher plans to design and compile a scientific attitude assessment instrument based on STEM EDP in science learning in elementary schools. At this stage, not only planning the creation of the instrument but also creating a teaching module for grade V on electrical energy aims to facilitate and improve the quality of learning in carrying out learning activities. The process of developing this instrument is carried out systematically through several stages. The design of the test items is carried out by referring to scientific attitude indicators. For example, the curiosity indicator is represented by statements such as "I always have a high curiosity about electrical energy materials" while the critical thinking indicator includes statements such as "I try to propose new solutions when facing problems in electrical energy products from batteries"

Figure 1. Scientific Attitude Assessment Instrument Product

The third stage is product development. Before being tested in the field, the product is validated by experts, the validation results state "Eligible" for field testing. The following is a recapitulation of the validation results in Table 1.

Table 3. Recapitulation of Expert Validation Results

Aspect	Score	Category
Material	75%	Worthy
Construction	79.17%	Worthy
Language	87.5%	Very Worth It
Average	**80.5%**	**Worthy**

Table 4. Recapitulation of Practitioner Validation Results

Aspect	Score	Category
Material	75%	Worthy
Construction	95.83%	Very Worth It
Language	87.5%	Very Worth It
Average	**86.11%**	**Very Worth It**

Based on the results validated by experts on the questionnaire, there are three aspects assessed using a Likert scale, namely material, construction and language. The material aspect received a score of 75% which was categorized as "Decent". In the construction aspect, the score obtained was 79.17% which was in the "Decent" category, meanwhile, the language aspect showed the highest score of 87.5% which was categorized as "Very Decent". Overall, the average score for the three aspects was 80.5%, so the questionnaire was declared "Appropriate" based on expert validation. And the results of the practitioner's scores are related to the feasibility of the questionnaire which will be tested in the field through three aspects, namely material, construction and language. It is shown in the table that the material shows a figure of 75% which is categorized as feasible. In the construction aspect, the score obtained was 95.83% which was included in the "very appropriate" category, meanwhile, the language aspect showed a score of "87.5% which was categorized as "very appropriate". Overall, the average score for the three aspects was 86.11%, so the questionnaire was declared "very feasible" based on the assessment of practitioners who would be tested in the field.

The fourth stage is the implementation of a small-scale initial trial conducted on a limited basis involving 10 students of class V Al-Khawarizmi. Based on the results of the initial trial, it can be concluded that students understand the scientific attitude questionnaire statements based on the STEM approach with the EDP model in learning electrical energy in series circuits. The fifth stage is to revise the instrument based on the findings based on the results of the initial field trial. Several terms were replaced with simpler and easier to understand ones.

The sixth stage is to conduct the main field test. The main field test activity was conducted in class V Al-Jazari in elementary school with 20 students as respondents. The data obtained from the field test were then analyzed using SPSS 30. The results of the analysis showed that the validity and reliability of the instrument wereif the calculated r value is greater than r table then the questionnaire is considered valid while if the calculated r value is smaller than r table the questionnaire is considered invalid. Validity testing is carried out to ensure whether a questionnaire is valid or not. A questionnaire is considered valid if its statements can really explore what is to be measured. So, validity aims to check whether the statements in the questionnaire that have been made are in accordance with what is to be measured (Ghozali 2016). In class V Al-Jazari, the number of scientific attitude assessment instruments based on the STEM approach with the EDP model was 30 questions developed.

The results of the reliability analysis showed 0.811 which was stated as very reliable. Meanwhile, the results of the validity analysis showed 15 questions were stated as valid and 15 other questions were invalid. Invalid questions because they do not match the indicators being measured, so the questions do not reflect what the research wants to know.

Table 5. Validation Results of Scientific Attitude Questionnaire Statements

Item No.	$_r$count	$_r$table 5% (18)	Criteria
1.	0.551	0.468	Valid
2.	0.526	0.468	Valid
3.	0.708	0.468	Valid
4.	0.659	0.468	Valid
5.	0.570	0.468	Valid
6.	0.754	0.468	Valid
7.	0.480	0.468	Valid
8.	0.459	0.468	Valid
9.	0.474	0.468	Valid
10.	0.490	0.468	Valid
11.	0.552	0.468	Valid
12.	0.521	0.468	Valid
13.	0.470	0.468	Valid
14.	0.685	0.468	Valid
15.	0.570	0.468	Valid

Table 6. Reliability of Scientific Attitude Questionnaire

Reliability Statistics

Cronbach's Alpha	N of Items
,811	30

The scientific attitude assessment instrument developed by the researcher was carried out using an observation sheet that was applied during the learning process The results of the recapitulation of the results of the scientific attitude assessment based on the STEM approach with the EDP model showed validity and reliability which showed 0.928 which was categorized as very reliable based on data obtained through the observation sheet. The results of the questionnaire sheet validation can be seen in tables 4 and 5.

Table 7. Observation Sheet Validation

No item	r count	r table 5% (18)	Criteria
1.	0.770	0.468	Valid
2.	0.913	0.468	Valid
3.	0.916	0.468	Valid
4.	0.856	0.468	Valid
5.	0.961	0.468	Valid

Table 8. Reliability of Observation Sheet

Scale Reliability Statistics

	Cronbach's α
scale	0.928

The seventh stage is dissemination and implementation, at this stage the product is disseminated through the EDP STEM edu website http://www.edustemedp.site. Aims to help schools measure scientific attitudes in elementary science learning.

The product of the STEM-based scientific attitude instrument with the EDP model using an assessment through a questionnaire on the five indicators that have been developed is expected to help teachers in assessing students' scientific attitudes effectively and support STEM-based learning with the EDP model. Based on the results of the product development which stated 15 valid questions, of the five indicators, the most appropriate for learning with the STEM approach using the EDP model are curiosity, critical thinking, responsibility, and cooperation because these four aspects support the process of exploration, problem solving, and collaboration in completing technology and engineering-based projects. This approach is designed to increase students' motivation, creativity, and understanding of science learning in elementary schools. This study provides a new contribution by developing a scientific attitude assessment instrument based on the STEM approach with the EDP model that has never been developed specifically in the context of elementary school science learning. Scientific attitudes are more widely carried out at the junior high or high school level. The instrument developed is specifically designed for elementary school students with relevant indicators, namely curiosity, cooperation, responsibility, objectivity and critical thinking. Existing research only assesses scientific attitudes in general without linking them to the STEM approach with the EDP model in this study scientific attitudes are assessed based on the EDP syntax. The STEM approach of the EDP model supports the implementation of an independent curriculum based on projects and problem solving. In this study, the assessment looks at how students apply scientific attitudes when solving engineering-based problems.

The obstacles faced when developing the instrument were that teachers did not yet know about STEM EDP-based learning, where researchers had to introduce or study the STEM approach with the EDP model that had to be studied in electrical energy material. The implementation of the STEM approach based on the Engineering Design Process (EDP) in elementary school classes faced various quite complex challenges. One of the main challenges was the limited understanding of teachers regarding the STEM concept and EDP stages as a whole. Many teachers were still not used to designing cross-disciplinary learning that integrated science, technology, engineering, and mathematics into one complete unit. In addition, the characteristics of elementary school students who were still in the concrete thinking stage were also a challenge in themselves. They needed a simpler, more visual, and more direct experience-based approach in order to understand each stage of EDP such as ask, imagine, plan, create, and improve. This required extra creativity and patience from teachers. Limited facilities and infrastructure in elementary schools, such as teaching aids, experimental materials, or access to technology, were also often obstacles. Many schools did not yet have adequate laboratory facilities or tools to support STEM-based projects.

The development of the STEM-EDP-based scientific attitude assessment instrument is still limited to the context of science learning in elementary schools with certain student characteristics and learning environments. Therefore, the generalization of the results to schools with different conditions, both in terms of resources, student background, and teacher readiness in implementing the STEM-EDP approach. Validation and testing of the instrument were carried out on a limited scale so that even though the initial results showed good validity and reliability, further research with a wider scope was needed to strengthen the findings. Teacher involvement in the implementation process also has variations depending on their understanding of the concept of scientific attitudes with the STEM EDP approach which can affect the consistency of instrument use in the field. In addition, the process of measuring affective and contextual scientific attitudes still faces its own challenges, especially in ensuring that the instrument can capture aspects of attitudes accurately and objectively in project-oriented learning. Scientific attitude assessment instruments that have been used in elementary schools are generally conventional, in the form of questionnaires or observations that are less contextual and do not describe the scientific thinking process in real terms. The innovation in STEM-EDP-based instruments lies in their integration with the Engineering Design Process stages that encourage students to demonstrate scientific attitudes directly when solving real problems. This instrument is more authentic because it measures scientific attitudes through activities that require observation, cooperation, perseverance, and reflection in the context of project assignments. This study contributes to education policy by providing a scientific attitude assessment instrument that is relevant to the STEM-EDP approach which is not yet widely available at the elementary school level. This instrument can be a reference in measuring and developing student character such as curiosity, critical thinking, and cooperation, which are in line with the objectives of the Merdeka Curriculum.

STEM-based science learning has a positive impact on student learning outcomes. Science learning outcomes with the STEM approach tend to be better compared to other subjects. This is due to the ability of STEM-based learning to increase student motivation and creativity when studying science. Although students do not fully understand the concept of STEM, they feel that this method encourages them to be more active in moving and thinking.(Mawaddah et., al2022). Science is not difficult, especially when combined with four main fields of science, namely science, technology, mathematics and engineering (STEM) using the EDP (engineering process design) model. With the STEM approach, students are more active in problem-solving activities. According to Aini et al., (2024) STEM is often paired with other learning models such as STEM through the Engineering Design Process (EDP) The engineering design process or EDP (Engineering Design Process) is a structured model for solving problems where concrete and functional solutions are developed through a series of step-by-step procedures (Syukri et al., 2023). Research conducted by Karimah (2022) shows that a positive attitude towards science learning can improve learning outcomes, especially if supported by learning methods and models that students prefer. Assessment of scientific attitudes in elementary school students can be done by grouping attitudes into certain dimensions or aspects. This approach makes it easier to compile scientific attitudes where each item in the instrument is developed based on relevant attitude indicators.

Improving scientific attitudes among students is one of the main goals of science learning which is closely related to the nature of natural science itself.Science learning motivates researchers and educators to design instruments to evaluate students' attitudes ((Widyastika & Wahyuni, 2022).Hidayah & Zanaton (2018) Scientific attitudes also have a positive impact on students' learning achievements. Development of valid and reliable scientific attitude assessment instruments as explained bySole & Anggraeni, (2017)can be used by elementary school teachers to evaluate students' scientific attitudes in supporting the success of the learning process.

Magdalena et al., (2020)states that "scientific attitude is very important in social life because it can shape human personality in making rational considerations when making a decision.". Scientific attitude also has a positive influence on student learning outcomes. This attitude reflects the behavior applied and developed by scientists to ensure the results obtained are in accordance with the objectives. Scientific attitude includes several aspects such as objective, critical thinking, cooperation, responsibility and high curiosity(Afifatussa' et al., 2021). By instilling scientific attitude values, it is expected that students will have a sense of curiosity to find answers to every material studied. Students are expected to be honest about the results of their thoughts, discussions, or activities such as observation reports and discussions. In addition, students need to be careful in observing various objects correctly, work hard in finding answers to problem formulations and never give up, continue to try to find alternative solutions through observation (Tursinawati et al., 2017). Scientific attitudes based on STEM EDP can increase students' high curiosity because the STEM approach of the EDP model is an approach and model that is centered on students, especially in implementing the practice of electrical energy in series circuits in grade V of elementary school. Scientific attitudes with the STEM EDP approach reflect that students meet the indicators of scientific attitudes.

Conclusion

This study shows that the STEM-EDP-based scientific attitude assessment instrument developed in science learning in elementary schools has met the criteria of validity and reliability and can be used to measure students' scientific attitudes effectively. This instrument has the potential to be applied in other schools with similar characteristics, so that it can support the improvement of the quality of STEM-based science learning more broadly and be considered in the formulation of educational policies that encourage the integration of the STEM approach in assessing scientific attitudes. However, this study has limitations in the scope of the trial which is still limited to one region and the number of samples is relatively small. Therefore, further research is recommended to expand the scope of the trial in various school contexts and different regions to test the consistency and generalization of the results. Opportunities for further development can be directed at integrating this instrument with digital technology to support platform-based assessments and the development of similar instruments for other subjects that also carry the STEM approach.

References

Afifatussa', I., Bektiarso, S., & Prihandono, T. (2021. Penerapan Model Pembelajaran Problem Solving Untuk Meningkatkan Sikap Ilmiah Dan Hasil Belajar Siswa Pokok Bahasan Energi Siswa Kelas IV SD islam Roudlotul Qur'an Mojokerto. 6(2) 122-133

Amelia, F. N., & Hamdu, G. (2022). Analisis kebutuhan instrumen penilaian sikap berbasis education for sustainable development di sekolah dasar. *Jurnal Fundadikdas (Fundamental Pendidikan Dasar)*, *4*(3), 215–224. https://doi.org/10.12928/fundadikdas.v4i3.4324

Aini, S. N., Munahefi, D. N., Pramasdyahsari, A. S., & Setyowati, R. D. (2024). PRISMA, Prosiding Seminar Nasional Matematika *Engineering Design Process* STEM: Projek Miniatur Gazebo Joglo. 7, 37–43. https://proceeding.unnes.ac.id/prisma

Gunada, I. W., Wahyudi, W., Ayub, S., Taufik, M., & Busyairi, A. (2023). Validitas Perangkat Model Project Based Learning Berbasis STEM pada Pokok Bahasan Perubahan Energi untuk Meningkatkan Sikap Ilmiah. *Empiricism Journal*, *4*(1), 134–144. https://doi.org/10.36312/ej.v4i1.1287

Ghozali, I. (2016). Aplikasi Analisis Multivariate dengan Program SPSS (Vol. 8). Semarang: Badan Penerbit Universitas Diponegoro.

Hastuti, S., & Marzuki, I. (2021). Model asesmen alternatif dalam evaluasi pembelajaran di era pandemi Covid-19. Tadarus Tarbawy: Jurnal Kajian Islam Dan Pendidikan, 3(1) 280-290 http://jurnal.umt.ac.id/index.php/cpu.

Hidayah, N. B. I., & Zanaton, B. H. I. (2018). Level of Chemophobia and Relationship with Attitude towards Chemistry among Science Students. Journal of Educational Sciences, 2(2), 52–65.

Iskandar, A., & Rizal, M. (2017). Analisis kualitas soal di perguruan tinggi berbasis aplikasi TAP. Jurnal Penelitian Dan Evaluasi Pendidikan, 21(2), 12–23. https://doi.org/10.21831/pep.v22i1.15609

Karimah, U. (2022). Pengembangan Instrumen Penilaian Sikap dengan Skala Intensi Proporsional. Journal of Multiliteracies. https://ejournal.multiliterasi.com/index.php/journal multiliterasi/article/view/19

Kuntarto, E., & Gustina, R. (2019). Pelaksanaan Penilaian Portofolio Di Sekolah Dasar. *Jurnal Gentala Pendidikan Dasar*, *4*(2), 190–200. https://doi.org/10.22437/gentala.v4i2.8437

Lin, K. Y., Wu, Y. T., Hsu, Y. T., & Williams, P. J. (2021). *Effects of infusing the engineering design process into STEM project-based learning to develop preservice 37 technology teachers' engineering design thinking. International Journal of STEM Education, 8(1). https://doi.org/10.1186/s40594-020- 00258-*

Magdalena, I., Meliana Sari, D., Hurrahmah, M., & Refiana Sari, N. (2020). Pengembangan Instrumen Penilaian Sikap Ilmiah Pada Pembelajaran Dengan Model Latihan Penelitian Di Sdn Rawakidang. In *EDISI: Jurnal Edukasi dan Sains* (Vol. 2, Issue 3). https://ejournal.stitpn.ac.id/index.php/edisi

Mawaddah, R., Triwoelandari, R., & Irfani, F. (2022). Kelayakan Lks Pembelajaran Ipa Berbasis Stem Untuk Meningkatkan Keterampilan Kolaborasi Peserta didik Sd/Mi. *Jurnal Cakrawala Pendas*, *8*(1), 1-14. https://doi.org/10.31949/jcp.v8i1.1911

Mediartika, N., & Aznam, N. (2018). Pengembangan instrumen penilaian portofolio berbasis multiple intelligence untuk mengukur kemampuan berpikir kritis dan sikap ilmiah. Jurnal Inovasi Pendidikan IPA, 4(1), 52–63. https://doi.org/10.21831/jipi.v4i1.9973

Putra, I. A. (2021). Pengembangan Instrumen Penilaian Untuk Mengukur Berpikir Kritis Pada Materi Tekanan Zat Untuk Peserta didik SMP (Doctoral dissertation, UIN Fatmawati Sukarno) http://repository.iainbengkulu.ac.id/id/eprint/7012

Putra, MJA, Mahdum, ANM, Natuna, DA, Syaflita, D., & Suryana, D. (2023). Development of the Engineering Design Process (EDP) on the Ability to Design Prototypes to Increase Natural Disaster Mitigation for Elementary Schools in Indonesia. Jurnal Internasional Teknologi Informasi dan Pendidikan , 13 (7), 1037-1050. doi: 10.18178/ijiet.2023.13.7.1903

Rahmadhani, F., Suryandari, K. C., & Susiani, T. S. (2021). Analisis Sikap Ilmiah Peserta didik Kelas Iv Dalam Pembelajaran Ipa Di Sdn 1 Tersobo Tahun Ajaran 2020/2021. Kalam Cendekia: Jurnal Ilmiah Kependidikan

Rika Yulia, Isrok'atun, & Ani Nur Aeni. (2024). Pegembangan KATARIAN Sebagai Media Edutainment Untuk Meningkatkan Kemampuan Berhitung Perkalian Siswa Kelas 3

Sekolah Dasar. *Jurnal Elementaria Edukasia*, *7*(1), 2303–2319. https://doi.org/10.31949/jee.v7i1.8263

Sole, F. B., & Anggraeni, D. M. (2017). Respon Guru Terhadap Instrumen Penilaian Sikap Ilmiah Sains Sekolah Dasar. *Jurnal Edukasi Sumba (JES)*, *1*(1). https://doi.org/10.53395/jes.v1i1.16

Song, T., Becker, K., Gero, J., Deberard, S., Lawanto, O., & Reeve, E. (2016). Problem decomposition and recomposition in engineering design: A comparison of design behavior between professional engineers, engineering seniors, and engineering freshmen. Journal of Technology Education, 27(2), 37–56. https://doi.org/10.21061/jte.v27i2.a.3

Syukri, M., Herliana, F., & Artika, W. (2023). *Development of Physics Worksheet based on STEM integrating Engineering Design Process (EDP) through Guided Inquiry Model to Improve Students' Critical Thinking. JPPPF (Jurnal Penelitian dan Pengembangan Pendidikan Fisika)* 9(2) 225-235. https://doi.org/10.21009/1

Tursinawati, S., Pd, I. M., & Pd. (2017). Analisis Kemunculan Sikap Ilmiah pada Rubrik Penilaian Sikap Subtema Macam-Macam Sumber Energi Di Kelas Iv Sekolah Dasar (Vol. 6, Issue 1).

Widiastuti, I., & Wawan Budiyanto, C. (2022). Pembelajaran STEM Berbasis *Engineering Design Process* untuk Sekolah Alam di Kabupaten Klaten. *DEDIKASI: Community Service Reports*, *4*(2) 121-132. https://doi.org/10.20961/dedikasi.v4i2.64923

Widyastika, D., & Wahyuni, N. (2022). Pengembangan Penilaian Sikap Ilmiah Berbasis Inkuiri Berorientasi Pendidikan Karakter pada Pelajaran IPA di Sekolah Dasar. *Jurnal Basicedu*, *6*(6), 9402–9409. https://doi.org/10.31004/basicedu.v6i6.4087

Yuliani, W., & Banjarnahor, N. (2021). Metode Penelitian Pengembangan (Rnd) Dalam Bimbingan Dan Konseling. *Quanta: Jurnal Kajian Bimbingan Dan Konseling Dalam Pendidikan*, *5*(3), 111–118. https://doi.org/10.22460/q.v5i3p111-118.3051