



Development of Green Chemistry-Based Practicum Module for Senior High School to Promote Students' Environmental Literacy

Noer Kurnia Dewi, Risnita Vicky Listyarini*

Chemistry Education Study Program, Universitas Sanata Dharma, Yogyakarta, Indonesia

*Email: risnita.vicky@usd.ac.id

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Abstract. Chemistry learning ideally should invite students to interact directly with the object being studied. This can be realized through a practicum in the laboratory. However, chemistry practicum still generates significant waste in the environment. There is also a need for character education to promote environmental literacy. Therefore, there is a need for a green chemistry-based practicum module for class X senior high school. This research aims to develop a green chemistry-based practicum module, to know the quality of a green chemistry-based practicum module, and to know the students' responses to environmental literacy. This a research and development using a modified Borg and Gall development model that includes information gathering, planning, product development, limited trial, and product revisions. The results of the validity of the green chemistry-based practicum module in terms of material had a percentage of 93.45% and in terms of media had a percentage of 90.00% with a very valid criterion. The use of the green chemistry-based practicum module gets a very practical criterion with a score of 86.67% based on students' responses. The green chemistry-based practicum module effectively increases students' learning outcomes which are marked by the n-gain value of 0.3 - 0.78 in the medium to high criteria. The value of $t_{count} > t_{table}$ and sig.(2-tailed) in three practicums < 0.05 indicates that the green chemistry-based practicum module can support students' environmental literacy.

Keywords: green chemistry-based practicum module; senior high school; environmental literacy

Introduction

Chemistry is one of the subjects which is quite abstract and contains material concepts with high difficulty to be understood by students. Students have difficulty understanding chemistry because students are not given a direct experience of a chemical phenomenon that involves macroscopic so chemistry is difficult to understand and learn (Sudiana et al., 2021; Sunyono, 2017). Chemistry subjects at the senior high school level are delivered in theory classes and are supported by a practicum in the laboratory. The existence of a practicum is expected to help students in constructing chemical concepts that are abstract and difficult to understand in theory. Students' mastery of chemistry is not only limited to concepts or theories but is broader in scientific thinking and science process skills (Andromeda et al., 2016; Maison et al., 2020)

The practicum method is practicum-based learning that is carried out directly by students. Through the practicum method, students are invited to prove and discover chemical concepts through practicum so that understanding concepts is not only limited to theory (Sari et al., 2021). Practicum is a learning method that can improve process observation, and curiosity, analyze practicum results and gain hands-on experience so

that students can prove or discover chemical concepts (Sunyono, 2017). Chemistry learning should invite students to interact directly with the object being studied so students get cognitive, affective, and psychomotor aspects of learning. This can be realized through practical activities. Through practical activities, students are invited to learn through direct experience so that they can construct their knowledge.

Practicum in high school is mostly done conventionally by following the procedures written in textbooks or textbooks. The practicum is carried out using a large number of chemicals and is harmful to the environment. It is not uncommon for many schools not to carry out practical activities due to limited laboratory facilities (Listyarini et al., 2019). The use of chemicals in large quantities and inadequate chemical waste disposal facilities can cause environmental pollution that endangers human health. Redhana and Merta (2017) state that chemical waste discharged into the environment can cause water, air and soil pollution. In addition, in the 2013 curriculum, character education is an aspect of attitudes and competencies that are considered very important in the learning process. This character education can be realized by integrating environmental literacy into the learning process (Moulia et al., 2018). Environmental literacy is very important to be applied in chemistry learning. This is because chemistry is very closely related to everyday life. By directing chemistry learning that supports environmental literacy, students can participate in preserving the earth. Liang et al. (2018) state that there are three indicators of environmental literacy, namely knowledge, attitudes, and behaviour.

Efforts to reduce the impact of waste generated from chemical practicum on environmental and human health are to minimize the use of chemicals or replace chemicals with other materials that are more environmentally friendly. Therefore, there is a need for a new approach to the implementation of chemistry practicum in learning. A new approach that can be developed is a green chemistry-based practicum. Green chemistry is an approach to chemical processes and the use of chemicals to reduce negative effects on the environment (Anastas & Warner, 1998). Twelve principles of green chemistry underlie the practicum and synthesis of green chemistry. The implementation of green chemistry principles can be done in practical learning. This is in line with the sustainable development agenda of the World Commission on Environment and Development (WCED) promotes to create green earth. One of the goals of the sustainable development agenda is to ensure environmental sustainability (Listyarini, 2019; Ngoyo, 2015).

Efforts to apply the principles of green chemistry in practicum are through the development of a green chemistry-based practicum module. The practicum module contains several principles of green chemistry that are applied to minimize problems caused by chemical processes carried out in the laboratory and support students' environmental concerns (Listyarini et al., 2019). The practicum module can be used as a reference and module for students in carrying out practicals so that students increasingly understand the work steps that must be done. The practicum module can guide students who have difficulty during practicum so that practicum objectives can be achieved optimally (Munzil et al., 2022).

Based on the problems above, it is necessary to develop a practicum module based on green chemistry. The practicum module is prepared to encourage students to be more aware of chemical waste generated from the practicum. Tools, materials, and work procedures are designed to minimize the use of hazardous chemicals and complicated equipment, and avoid the formation of hazardous chemical wastes to realize an easy practicum without being constrained by chemicals. The main objective of developing this module is to support the environmental literacy of students. The purpose of this research is to develop a green chemistry-based practicum module, to find out the quality of the practicum module in terms of validity, practicality, and effectiveness, and to know the response of students to environmental literacy.

Methods

This research is development research designed to follow the modified development model of Borg and Gall (1983). The development model includes five stages, namely information gathering, planning, product development, limited trial, and product revision. The information collection was carried out through interviews with chemistry teachers in two high schools in Yogyakarta and then a needs analysis was determined based on the results of the interviews. Needs analysis includes analysis of learning resource needs, syllabus analysis, and material analysis. The planning stage includes the stages of collecting literature, designing practicum and developing research instruments. The instruments used in this study were interview sheets, validation sheets, students' response questionnaires, pretest and posttest, and observation sheets. The students' response questionnaire consists of two questionnaires which are the students' response questionnaire to the practicum module and environmental literacy. The product development stage includes the stages of preparing the module format, validation, and product revision based on suggestions from the validators. The limited trial stage is performed on seven students of class X in one of the private senior high schools in Yogyakarta. Product revision is performed based on suggestions from students.

The product was evaluated by validators. The feasibility of the practicum module was evaluated from material and media aspects. The validity percentage is categorized with the feasibility criteria level from Table 1.

Table 1. Feasibility level criteria

No	Validity (%)	Criteria
1.	81 - 100	Very valid
2.	61 - 80	Valid
3.	41 - 60	Valid enough
4.	21 - 40	Less valid
5.	20	Invalid

Students' response questionnaires to the practicum module and environmental literacy were analyzed. Each statement has a value of 1 - 5 which is then analyzed to determine the environmental literacy of students on aspects of attitude and behavior. Analysis of students' response questionnaire data on environmental literacy refers to (Yanti et al., 2013). The scores obtained are then converted into qualitative data with the guidelines contained in Table 2.

Table 2. Guidelines for Environmental Literacy Criteria

No	Score	Criteria
1.	4.7 – 5.00	Very good
2.	3.7 – 4.69	Good
3.	2.7 – 3.69	Fair
4.	2 – 2.69	Low
5.	<1.99	Very low

(Arikunto, 2013).

Results and Discussion

The results follow the development model stage of the modified development model of Borg et al. (1983).

Information Gathering Stage

The product development stage includes several stages, namely collecting initial information through interviews and formulating needs analysis. Based on the results of the analysis of learning resources, a practical module is needed to support practicum activities. The development of a green chemistry-based practicum module follows the revised 2013 curriculum.

Planning Stage

The planning stage includes searching for literature and designing practicum procedures. The practicum procedure is designed by modifying the practicum design that has been carried out in relevant research (Fitriyana, 2017; Moulia et al., 2018; Zikriana & Hamid, 2017). Modifications made include replacing chemicals with materials that exist in everyday life. The use of environmentally friendly materials used in relevant research is then adapted in the design of this practicum. The practicum design trial is carried out to prove that the practicum design can be carried out. The trial was conducted at the Chemistry Laboratory of the Chemistry Education Study Program, Universitas Sanata Dharma. The practicum plan is as follows.

a. Electrolyte and Nonelectrolyte Solutions

Electrolyte and nonelectrolyte solution practicum was carried out by testing various kinds of solutions that exist in everyday life, namely kitchen salt solution, chili solution, garlic solution, honey solution, commercial isotonic solution, and nail cleaning solution.

b. Reduction and Oxidation in Daily Life

In the practicum of reduction and oxidation reactions, there are two activities, namely redox reactions on vitamin C and redox reactions on PK (Potassium Permanganate) drugs. The first activity was carried out by reacting ascorbic acid or vitamin C with the formula $C_6H_8O_6$ which is found in various fruits with iodine. The ingredients used are citrus fruits, tomatoes, and chillies.

c. Lavoisier's Law and Proust's Law

In Lavoisier's law and Proust's law practicum, there are three activities which are Lavoisier's law practicum on the reaction of baking soda with orange juice; Lavoisier's law practicum on starch reaction with iodine, and Proust's law practicum on chalk burning reaction. The first and second activities are carried out by comparing the mass of the substance before reacting with the mass of the substance after the reaction. The third activity is done by burning chalk.

Development Stages

The development stage includes the preparation of the module format. The format of the green chemistry-based practicum module developed are as follows a) front cover; b) introductory section (contains an explanation of the principles of green chemistry in general and in each practicum); c) laboratory safety; d) practicum procedure; e) reflection as a form of students' evaluation regarding the values of attitudes, feelings after conducting each practicum. Reflection activities are very important in learning to create a more meaningful and sustainable practicum. Reflective learning is a major part of the experience-based learning process (Rais & Aryani, 2019). Reflective learning is a major part of the experience-based learning process. The existence of reflection activities is a characteristic of constructivist learning. The cover of the practicum module is presented in Figure 1.



Figure 1. Front and back cover of practicum module

The practicum module is validated in terms of material and media validation. The validation is performed by two chemistry teachers and two lecturers at Chemistry Education Study Program, Universitas Sanata Dharma. The results of material validation from the four validators are in Table 3.

Table 3. Material Validation Results

Aspects	Validity Average (%)	Criteria
Statement characteristics	88.57	Very Valid
Construction	97.14	Very Valid
Language	95.00	Very Valid
Percentage of Overall Aspect	93.45	Very Valid

The quality of the green chemistry-based practicum module in terms of the material consists of aspects such as self-instructional, self-contained, stand-alone, adaptive, and user-friendly indicators got an average value of 88.57% with a very valid criterion. The green chemistry aspect which consists of indicators of the use of green chemistry principles in practicum gets an average value of 97.14% with very valid criteria. Aspects of environmental literacy which consists of indicators of knowledge, attitudes, and behavior get an average value of 95% with very valid criteria (Arikunto, 2013). The average value of all aspects of the four validators is 93.45% with very valid criteria. Based on the scores obtained from the four validators, it can be concluded that the quality of the material in the green chemistry-based practicum module is considered very valid and suitable for use in limited trials with slight revisions based on suggestions from the validators. A practicum module with very valid qualifications means that the product does not need to be revised so that it can be used in limited trials (Agung, 2005). The validation results in terms of media from four validators are shown in Table 4.

Table 4. Media Validation Results

Aspects	Validity Average (%)	Criteria
Quality Element	88.08	Very Valid
language	92.14	Very Valid
Practicality	93.33	Very Valid
Percentage of Overall Aspect	90.00	Very Valid

The quality of the green chemistry-based practicum module in terms of media feasibility on aspects of quality elements consisting of indicators of the use of format, organization, attractiveness, font shape and size, space, motivation, reference writing, and students' involvement gets an average score of 88.08% with very valid criteria. The linguistic aspect which consists of indicators of readability, clarity, and conformity language gets an average value of 92.14% with very valid criteria. Practical aspects which consist of ease of use, ease of carrying, and the size of the practicum module get an average value of 93.33% with very valid criteria (Arikunto, 2013). The average value of all aspects of the four validators is 90.00% with very valid criteria. Based on the scores obtained from the four validators, it can be concluded that the quality of the green chemistry-based practicum module in terms of the media is considered very valid and suitable for use in limited trials with revisions based on suggestions from the validators. Product quality with very valid qualifications means that the product is not revised so that it can be used in limited trials (Agung, 2005). The green chemistry-based practicum module was revised according to the suggestions given by the four validators including revision of content or material, design, and writing.

Limited Trial Stage

The limited trial was attended by seven students of class X in one of the private senior high schools in Yogyakarta. The trial was conducted in April 2021 which consisted of two meetings. Practical activities were carried out at the high school chemistry laboratory in Yogyakarta using the Small Scale Chemistry (SSC) kit owned by the Chemical Education Department, Universitas Sanata Dharma (Listyarini et al., 2019).

The limited trial was performed in two meetings. At the first meeting, the students conducted Practicum 1: Electrolyte and Nonelectrolyte Solutions and Practicum 2: Reduction and Oxidation Reactions in Daily Life. The pretests were carried out before the practicum was carried out. Students did a practicum in groups divided into three groups consisting of two to three students. Students worked on a worksheet on the results of the practicum containing observational data, post-practice questions, and reflections that must be done in groups. Students engaged in active discussions to fill in the worksheets given. Students worked on posttest questions after completing each practicum title. Through this posttest question, the cognitive abilities obtained after doing the practicum can be analyzed. The activities carried out by each student during the practicum were observed by the observer. At the second meeting, students conducted Practicum 3: Lavoisier's Law and Proust's Law. The pretest was carried out before the students do the practicum. At the end of each practicum students were asked to measure and weigh the waste generated during the practicum and review the level of danger of the waste. The activity was carried out to increase students' awareness of the environment and provide insight to students that green chemistry-based practicum can minimize the formation of waste. At the end of the practicum students did the posttest.

Students were asked to fill out a student response questionnaire for the green chemistry-based practicum module and a response questionnaire for environmental literacy at the end of the practicum. The results of the students' response questionnaire to the practicum module are used as an indicator of the practicality of the practicum module. The purpose of the practicality analysis is to determine the level of usability of the developed product where the practicality data of the practicum module is obtained from filling out students' response questionnaires after using the practicum module (Darmayanti et al., 2020). The practicality of the practical module is presented in Table 5.

Table 5. Students' Questionnaire Results on the Practicum Module

Student Code	Practicality (%)	Criteria
A1	90.91	Very Practical
A2	82.73	Practical
A3	83.64	Practical
A4	81.82	Practical
A5	82.73	Practical
A6	94.55	Very Practical
A7	87.27	Very Practical
Average	86.23%	Very Practical

From students' responses, it is obtained the practicality of the practicum module. The green chemistry-based practicum module that was developed got an average score of 86.23% in the very practical criteria. This means that the developed green chemistry-based practicum module can be used properly by students (Darmayanti et al., 2020). In addition, the existence of a practicum module can help students to achieve learning goals (Prabowo et al., 2016).

The results of the students' pretest and posttest scores were used to determine the N-gain. N-gain is an inferential statistical analysis to determine the magnitude of the increase in students' learning outcomes after learning (Yusuf, 2018). The value of N-Gain is used to see the effectiveness of using a green chemistry-based practicum module. The effectiveness of developing practicum modules can be seen from the achievement of learning objectives, namely an increase in the quality of learning after using learning tools (Prabowo et al., 2016). The quality of learning can be seen in the process and learning outcomes. The N-gain value of students in the three practicums is presented in Table 6.

The n-gain value of students in Practicum 1 ranges from 0.37 to 0.73. The n-gain score between 0.30 – 0.70 is in the medium criteria and above 0.70 is in the high criteria (Hake, 1999). In Practicum 1, six students experienced an increase in learning outcomes in the medium criteria and one student experienced an increase in learning outcomes in the high criteria. The N-gain in the Practicum 2 ranges from 0.5 to 0.78. In Practicum 2 the seven students experienced an increase in learning outcomes in the medium criteria. N-gain in the Practicum 3 ranges from 0.3 to 0.75. In Practicum 3, six students experienced an increase in learning outcomes in the medium criteria and one student experienced an increase in learning outcomes in the high criteria.

The N-gain obtained in the three practicums is in the medium and high categories. This shows that students are quite actively involved in the learning process assisted by the green chemistry-based practicum module so that there is an increase in learning outcomes in the medium and high categories. The increase in learning outcomes is due to practical learning, students get direct experience. Sasongko et al., (2020) stated that through practicum, students' understanding of chemical concepts is deeper because students can see directly chemical phenomena clearly so that they get more information. If the understanding of chemical concepts are deeper, the students' chemistry learning outcomes can be maximized (Herawati et al., 2013; Listyarini et al., 2020). Practicum is needed in science learning. Practical activities can encourage students to have a deep understanding of scientific concepts and shape students to become scientific thinkers (Eggen & Kauchak, 2012)

Table 6. N-Gain Value of Students

Student Code	N-Gain		
	Practicum 1	Practicum 2	Practicum 3
A1	0.67	0.69	0.57
A2	0.60	0.69	0.67
A3	0.45	0.40	0.75
A4	0.68	0.62	0.30
A5	0.38	0.70	0.25
A6	0.37	0.78	0.45
A7	0.73	0.50	0.64

One of the things that should be considered in carrying out the practicum is the existence of a practicum module that is based on the learning objectives. Thus, the development of a green chemistry-based practicum guide developed has good effectiveness in supporting practicum activities because it can improve students' learning outcomes.). Improving the quality of learning is marked by an increase in maximum learning outcomes, one of which is influenced by teaching materials, media, and facilities to achieve learning objectives (Suparno, 2004). Based on this, the chemistry-based practical guide included in the practical teaching materials is useful in supporting practical activities. This is in line with the purpose of the practicum guide, which is to provide guidelines for students so that learning objectives can be achieved optimally. The function of the practicum guide is to minimize the teacher's role, students become more active, gain meaningful knowledge and make it easier for teachers to carry out learning in the laboratory so that learning objectives can be achieved (Arifah et al., 2014).

Observation of students' science process skills aims to review the psychomotor abilities of students during a green chemistry-based practicum. Science process skills are the skill and ability to act after getting a learning experience (Syaiful, 2003). The indicators observed were the ability of students to use laboratory equipment, use materials wisely, and do practicum correctly. The science process skills of students during practicum with a green chemistry-based practicum module are presented in Table 7.

Table 7. Students' Science Process Skill

Student Code	Science Process Skill (%)		
	Practicum 1	Practicum 2	Practicum 3
A1	66	92	96
A2	64	94	96
A3	64	92	94
A4	76	94	94
A5	66	90	96
A6	72	94	94
A7	72	92	92
Average	68.57	92.57	94.57

The science process skills of students in the Practicum 1 ranges from 64-72% with good criteria. Science process skills in Practicum 2 range from 90-94% with very good criteria. The science process skills of students in Practicum 3 ranged from 92% - 96% with very good criteria. Science process skills with scores above 86% are in the very good category (Arikunto, 2007). All students have science process skills with a very good category in Practicum 2 and 3. The science process skills of students have increased from Practicum 1 to Practicum 3. This shows that the green chemistry-based practicum module can be used to measure science process skills. Chemistry practicum with a green

chemistry-based practicum module has effectiveness in improving students' learning outcomes. Students' science process skills can support the achievement of students' learning outcomes (Astuti et al., 2019). The students' science process skills score was lowest in Practicum 1 compared to the latter because Practicum 1 was their first experience in carrying out practicum. Students were confused and unfamiliar with using the SSC kit. The experience possessed by students can affect students' science process skills because the development of science process skills occurs when students get direct experience to perform certain physical actions and use various materials or materials (Ekene, 2011). However, after students got the direct experience to use the laboratory equipment, students' science process skills increased. This shows that habits and exercises that are carried out continuously can shape and grow students' science process skills (Rusmiyati & Yulianto, 2009)

There are three aspects of environmental literacy, namely aspects of knowledge, attitudes, and behavior (Liang et al., 2018). The knowledge aspect was analyzed from the pretest and posttest scores, while the behavioral and attitude aspects were analyzed from the student's response questionnaire to environmental literacy after conducting a practicum with a green chemistry-based practicum module. The environmental literacy abilities of seven students in class X in one of the senior high schools in Yogyakarta are listed in Table 8.

Table 8. Environmental Literacy Ability in Aspects of Students' Attitudes and Behaviors

Student Code	Score	Criteria
A1	4.33	Good
A2	3.96	Good
A3	3.79	Good
A4	4.08	Good
A5	3.67	Fair
A6	4.46	Good
A7	4.46	Good
Average	4.11	Good

The results of the environmental literacy analysis were further analyzed to find out every aspect possessed by all students. The analysis of the aspects of attitudes and behavior is presented in Table 9.

Table 9. Environmental Literacy Ability in Aspects of Students' Attitudes and Behaviors

Aspect	Indicator	Average	Criteria
Attitude	awareness and sensitivity to the environment	4.43	Good
	environmental values	4.21	Good
	decision-making attitude on environmental issues	4.07	Good
Behavior	intention to act	4.29	Good
	environmental action	3.83	Good
	responsible behaviour	4.19	Good

Environmental literacy skills on aspects of attitude and behavior of senior high school students grade X in Yogyakarta are in the range of 3.67 - 4.46 with good criteria. One student has environmental literacy skills in the medium criteria and six students in the good criteria. Overall, the average ability of environmental literacy on the aspects of students' attitudes and behavior has good criteria. The attitude aspect is divided into three indicators of awareness and sensitivity to the environment, environmental values,

and decision-making attitudes about environmental issues. The environmental literacy ability on the indicators of environmental awareness and sensitivity owned by students gets an average score of 4.43 with good criteria. Indicators of environmental values get an average score of 4.21 in the good criteria. Indicators of decision-making attitudes about environmental issues get an average score of 4.07 with good criteria. Behavioral aspects are divided into three indicators, namely intention to act, environmental action, and responsible behavior. The ability of environmental literacy on the indicators of an intention to act owned by students gets an average score of 4.29 with good criteria. Indicators of action on the environment get an average score of 3.83 with good criteria. Responsible behavior indicators get a score of 4.19 in the good criteria. Students have environmental literacy skills with good categories in the aspects of attitude and behavior.

The knowledge aspect of environmental literacy can be observed from the n-gain value and the paired sample t-test which were analyzed using SPSS. The results of the Shapiro Wilk normality test on the pretest and posttest values of the three practicums were in the range of 0.061 – 0.918. All data in this study were normally distributed so that a paired sample t-test could be performed. The data were normally distributed so that further analysis was carried out, namely, hypothesis testing using the paired sample t-test with $\alpha = 5\%$. The results of the paired sample t-test are presented in Table 10. The hypotheses in this test are:

Ho: The use of a green chemistry-based practicum module cannot support the environmental literacy skills of students in class X in senior high school at Yogyakarta.

Ha: The use of a green chemistry-based practicum module can support the environmental literacy skills of students in class X in senior high school at Yogyakarta.

Table 10. Paired Sample t-test Results

	t_{count}	t_{table}	Criteria	sig.(2-tailed)	Criteria
Practicum 1	6.33	2.015	$t_{count} > t_{table}$	0.001	sig.(2-tailed) < 0,05
Practicum 2	11.6	2.015		0.000	
Practicum 3	7.251	2.015		0.000	

The results of the paired sample t-test in the first practicum with a t_{count} of 6.33 and a sig. (2-tailed) value of 0.001. In the second practicum, the t_{count} value was 11.6 and sig.(2-tailed) was 0.000. In the third practicum, the t_{count} value was 7.251 and sig.(2-tailed) was 0.000. The value of t_{table} with df of 5 and the test of $\alpha = 5\%$ is 2.015. The calculated t value of the three practicums is greater than the t_{table} and the value of sig.(2-tailed) at the value of sig.(2-tailed) < 0.05. From t-test, it is found that $t_{count} > t_{table}$ or significance value < 0.05, means that Ho is rejected and Ha is accepted (Ghozali, 2011.). Based on this, it can be concluded that the use of a green chemistry-based practicum module can support the environmental literacy skills of students in class X SMA in Yogyakarta.

Product Revision

The revision of the green chemistry-based practicum module was not carried out. This is because the response of students to the practicum module is good and there is no suggestion or input from students. The final product of the green chemistry-based practicum module product is the revised product of the validator used in a limited trial.

Conclusion

Based on the results, the quality of the green chemistry-based practicum guide based on the validation in terms of material is 93.45% with very valid criteria and in terms of media is 90.00% with very valid criteria. The use of green chemistry-based practicum guides gets very practical criteria with a score of 86.67% based on students'

responses. The green chemistry-based practicum guide is effectively used to increase students' learning outcomes in Practicum 1 – 3 with an n-gain value of 0.3 - 0.78 in the medium and high categories. The effectiveness can also be seen from the students' science process skills with an average of 85.23% for Practicum 1-3 with very good criteria. Overall, aspects of attitudes and behaviour regarding the environmental literacy abilities of students are good criteria. Based on the statistical test paired sample t-test using SPSS, it can be concluded that the use of the green chemistry-based practicum module can support the environmental literacy skills of students in class X SMA in Yogyakarta.

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