Feasibility Analysis of Chemistry Practicum Guide Book for Class XI Based on BNSP Integrated Green Chemistry

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Abstract. This study aims to determine the feasibility of the chemistry practicum guide for class XI circulating according to the BNSP integrated green chemistry. This research method uses descriptive qualitative method. The samples used in this study were several practical handbooks circulating in schools. The research instrument is in the form of a feasibility sheet based on the BNSP integrated green chemistry. The results of this study are the books used by the school are in accordance with the curriculum and according to the BNSP standards for integrated green chemistry. Where the average value is 77.3% with a decent and valid category for use by students. Where each percentage of the content feasibility category is 59.17%, language eligibility is 90.63%, presentation eligibility category is 70.83%, and graphic eligibility category is 88.54%.

Keywords: Pratical guide, Chemistry, BNSP Integrated green chemistry

1 Introduction

Law chapter 1 article 1 number 1 which states that education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by himself, society, nation and state (1). Besides that, in accordance with the Indonesian Curriculum, namely the 2013 Curriculum (K-13), learning is required to be more oriented to the character development of students. This study aims to determine the feasibility of a chemistry practicum guide for class XI circulating according to the National Education Standards Agency (BSNP) integrated green chemistry, after determining the time for the practicum which will be carried out at the practicum place, a green chemistry-based guide book with the BNSP integrated green chemistry will be made.

Chemistry is a science that studies matter, its properties, structure, and reactions or changes that occur and are abstract in terms of concepts, principles, and calculations related to everyday life. Chemistry cannot be learned simply through reading, writing, or listening.

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Mastery of chemistry is measured through the ability to master a collection of chemical knowledge and skills to do scientific work (2).

The implementation of the practicum is expected to provide evidence of the truth of the theory or concept that has been studied by students so that the theory or concept becomes more meaningful in its cognitive structure (3). Practicals carried out by almost all schools, especially high schools (SMA) are conventional chemistry practicum methods. The process carried out is generally found in textbooks and uses industrial synthetic chemicals. This practicum uses the principles of chemical reactions, such as the formation of precipitates, the occurrence of color changes, the formation of gases, or the occurrence of changes in temperature (4).

Practical activities are part of learning that aims to give students the opportunity to prove theories in real situations by testing and conducting experiments directly. Experiment-based teaching and learning activities need to be carried out in chemistry learning. Chemistry learning emphasizes the process skills possessed by students. Experiment-based activities make it easier for students to understand the material being studied because students can be directly involved in the learning process (5). The teaching and learning process with the practicum method will provide opportunities for students to experience for themselves a process of observation, analysis, proof and drawing conclusions. Thus, students are required to experience for themselves, seek the truth, or try to find a law or proposition, and draw conclusions from the process they experience (6).

Hayat and Anggraeni state that in the teaching and learning process with the practicum method students are given the opportunity to experience themselves or do it themselves, follow a process, observe an object, analyze, prove and draw their own conclusions about an object, state or process of something (7). The evaluation of the practical guide learning was analyzed consisting of four parts, namely content feasibility, language feasibility, presentation feasibility and graphic feasibility. The results of the feasibility analysis of the chemical practicum guide distributed based on the standards of national educational (8).

Meanwhile Rahman, et al explained the results of case study analysis conducted in a number of high schools in Medan that, the area of chemical laboratories in several schools in Medan met the BSNP standards, but there were still science laboratories used for chemistry laboratories (9). In addition to having many benefits, the implementation of the practicum has several consequences, including the disposal of waste from the results of the practicum and work safety in the laboratory. In general, students do not know the rules while in the laboratory, the properties of practicum materials, the dangers of chemicals, and symbols contained in the laboratory, how to use laboratory equipment, and proper waste disposal. If this problem is left unchecked, it will not be controlled and can endanger the safety of students. Therefore, students need a safe and environmentally friendly practicum for the emergence of dangerous diseases and accidents when doing practicum.

Green Chemistry provides twelve principles for designing chemical processes by default. Green Chemistry supports the goal and covers a larger scope including teaching, laboratories and the chemical industry. Green Chemistry has 12 principles, namely: “(1) prevention; (2) atomic economy; (3) less hazardous synthetic chemicals; (4) designing safer chemicals; (5) safer solvents and auxiliaries; (6) design for energy efficiency, (7) use of renewable raw materials; (8) lowering the derivative; (9) catalysis; (10) design for degradation; (11) real time

analysis for pollution prevention; and (12) chemicals that are inherently safer for accident prevention" (10).

According to Green Chemistry, the chemicals used in addition to being safe for users (teachers and students), must also be friendly to the environment. This means that the waste generated from chemical processes such as experiments in laboratories or practicums must be harmless to creatures and the environment. Waste must be easily degraded by microorganisms that exist in nature. These materials can be obtained easily and cheaply. Thus, students can also save the environment from environmental pollution caused by plastic waste (11).

2 Research Method

This research method uses a qualitative descriptive method. The sample used in this study were several practical guide books circulating in schools. The research instrument is a feasibility sheet based on BNSP integrated green chemistry. The data in this study are the results of the analysis of 4 chemistry practical guide books for class XI based on BSNP integrated green chemistry. The research data uses data on the analysis of chemical practicum guidelines based on BSNP integrated green chemistry.

At this stage, an analysis of the practicum guides circulating in several schools will also be carried out to determine the characteristics, material and content in the guides that are often used by teachers to carry out practicum. The assessment of the practicum guide includes practicum materials, tools and materials used, the feasibility level is assessed using a chemical practicum guide validation instrument in accordance with BNSP. descriptive analysis by paying attention to aspects including display format, material, and language presentation. The considerations in assessing this practicum guide use the comparison formula in Equation 1 and the comparison of the practicum guide in Table 1.

$$\text{Percentage of eligibility scores} = \frac{score\ obtained}{\max score} \text{x } 100\% \qquad (1)$$

Table 1. Media Eligibility Assessment Percentage Score

No	Percentage Rate (%)	Criteria
1	81 – 100	Very Worthy
2	61 – 80	Worthy
3	41 – 60	Decent enough
4	21 – 40	Not feasible
5	0 – 20	Very Unworthy

3 Results and Analysis

The main activity in this research is to analyze the practicum guide books circulating in schools. The use of practicum guides that are not in accordance with BNSP integrated green chemistry is a major concern. Based on the results of the BNSP assessment sheet on practicum books circulating in schools, it can be analyzed and obtained the following results

Table 2. Result Content Eligibilty

No	Content Eligibilty	Score Max	Score Get	Percentage (%)	Information
1	Book Organization Practical Guide	8	5	62,5	Worthy
2	Material Coverage	12	9	75	Worthy
3	Concept Truth	12	10	83,33	Very Worthy
4	Mustan Contents of the Praticum Guide	8	3	37,5	Not Feasible
5	Pratical Guide Innovation	8	3	37,5	Not Feasible
	Acerage Percentage			59,17	Decent Enough

Table 3. Language Eligibility Result

No	Language Eligibility	Score Max	Score Get	Percentage (%)	Information
1	In Line with the Development of Learners	8	6	75	Worthy
2	Aspects of Sentence Claruty and Readability	8	7	87,5	Very Worthy
3	Writing Aspect	4	4	100	Very Worthy
4	Aspects od Using Language, Terms and Symbols	4	4	100	Very Worthy
	Average Percentage			90,63	Very Worthy

Table 4. Presentation Result

No	Serving Eligibility	Scor Max	Score Get	Percentage (%)	Information
1	Guidebook Component Practicd	12	9	75	Worthy
2	Aspects of Guiding Presentation Pratice	4	2	50	Decent Enough
3	Level of Existence Practicum	8	6	75	Worthy
4	Evaluation	12	10	83,33	Very Worthy
	Average Percentag			70,83	Worthy

Table 5. Graphic Result

No	Graphic Eligibility	Score Max	Score Get	Percentage (%)	Information

1	Raw Leather Design	12	10	83,33	V ery Worthy
2	Book Content Desain	16	15	93,75	Very Worthy
	Average Percentag			88,54	Very Worthy

Based on the analysis of the value of the content feasibility aspect, the result is 59,17% (Decent Enough) can be seen in the table 2, meaning that the books circulating in schools are in accordance with the BSNP but can be redeveloped. From the aspect of language feasibility, the results of the analysis obtained are 90,63% (very worthy) can be seen in the table 3, meaning that the language aspect used in the circulating practicum guidebooks does not need to be revised. Furthermore, the results of the feasibility aspect of the presentation obtained results of 70,83% (worthy) can be seen in the table 4, meaning that the practical guide books circulating in schools can be added to Core Competencies (KI) and Basic Competencies (KD) as well as work safety in the laboratory and some instructions on how to work laboratory equipment. Some practical implementations are also difficult for students to carry out directly because they are quite dangerous, practicum designers can be made safer for students and environmentally friendly. Based on the results of the feasibility aspect of the graphic, the result is 88,54% (very worthy) can be seen in the table 5, based on the BSNP so that it does not need to be revised again.

From the overall results of the analysis of practicum books circulating in schools, it was found that the average value of the BNSP results was 77,3% (Worthy), the class XI practicum guidelines circulating in schools were suitable for use by students according to the BSNP, but there were some improvements such as making experiments safe for students and environmentally friendly should also be done. After this analysis is carried out, a practical guide book that is safer for students and also environmentally friendly in the form of a green chemistry-based practicum guide book will be developed.

Guide natural material-based high school chemistry practicum that has been designed to be valid and suitable for use class XI high school students. The percentage of the validity score obtained is 72,3% and the percentage score location obtained 72,7% (12). Then based on research that has been done by Jumasari (13), the class XII chemistry practical manual used in schools is in accordance with the BSNP and is suitable for use but needs to be developed according to the 2013 curriculum, considering that the practical guide book still uses the KTSP curriculum.

Ekin (14) explained the results of the analysis of the 3 practical guide books are still found a number of weaknesses and shortage, development is carried out project-based practicum guide and standard character according to BSNP criteria, it is expected that learning can grow student character is innovative, creative, affective, productive, collaborative, disciplined, and contribute to improving learning outcomes student chemistry. The research that has been carried out by Manalu (15) describes the chemical practicum guide book which was developed based on contextual research so that students can easily carry out practical activities because one of the components of contextual learning is constructivism which means building their own knowledge through everyday experience.

4 Conclusion

The feasibility level of the chemical practicum guide circulating in class XI schools has a suitable category for use based on the BSNP but it is not safe for students and the environment because many practicums use hazardous chemicals, where the average value of the BNSP practical guide book is 77.3% (Worthy) where the category is feasible and valid for use by students. Where each percentage of content eligibility category is 59.17%, language eligibility is 90.63%, presentation eligibility category is 70.83%, and graphic eligibility category is 88.54%.

Practical guide books circulating in schools can be updated with the addition of KI and KD as well as work safety in the laboratory and some instructions on how to work laboratory equipment. Some practical implementations are also difficult for students to do directly because they are quite dangerous, practicum designers can be made safer for students and environmentally friendly by applying the concept of green chemistry.

References

[1] **Depdiknas.** *RI Law Number 20 of 2003 National Education System.* Jakarta, 2003. s. 173-179. Zv. 2.

[2] *Developing an interactivevirtual chemistry laboratory enrichedwith constructivist learning activities for secondary school.* **Altun, E., Demirdag, B., Burak, F., Alev, A., and Iker, C.,.** 1, s.l. : Procedia Social and Behavior Science, 2009, Jurnal Pendidikan Kimia, Zv. 1, s. 95-104.

[3] *Improving Students Science Process and Critical Thinking Skills Using Semi-Research Patterns Practicum.* **Jahro, I, S., Darmana, A and Sutiani, A.,.** 1, s.l. : Jurnal Tadris Kimiya, 2021, Zv. 6.

[4] *The Effect of Green Chemistry Practicum on Students' Attitudes towards Chemistry.* **Redhana, I, W., Suardana, I, N., Selamat, I, W., and Merta, L, M.,.** 2, s.l. : Edusains, 2020, Prosiding SEMIRATA 2013, Zv. 12.

[5] *Green Chemistry-Based Practical Handbook for SMA/MA Class XI.* **Rahmawati, S.,.** 1, s.l. : Journal of Tropical Chemistry Research & Education, 2019, Zv. 1.

[6] *Green Chemistry Approach in Environmental Chemistry Practicum Module to Increase Creativity of Chemistry Teacher Candidates.* **Idrus, S, W, A., Hadisaputra, S., Dan Junaidi, E.,.** 2, s.l. : Chemistry Education Practice, 2020, Zv. 3.

[7] *Scientific Attitude of Practicum Based Learning Students On Invertebrate Concept To Students Scientific Attitude Development.* **Hayat, M. S., & Anggraeni, S.,.** s.l. : Research journal, 2011, Jurnal Inovasi Pembelajaran Kimia, Zv. 2, s. 64-70.

[8] *Analysis of Chemical Practicum Guides for Learning Evaluation Based on the National Education Standards.* **Berutu, A. F. Jahro, I. S and Sitorus, M.,.** Medan : Proceedings of The 5th AISTEEL, 2020, In Talenta Conference Series, Series 2, s. 192-198.

[9] *Analysis of constraints and alternative solutions to the implementation of chemical practicums in several high schools in Medan.* **Rahman, G., Nasution, R. F., Lubis, A. R., Novira, P., Rahman, L., Sinaga, E. H. R., Thaharah, P. I. M., Afrida, S. N., Suyanti, R. D., Darmana, A., and Silaban, S.,.** 1, s.l. : Journal of Chemistry Education, 2020, Zv. 12.

[10] **Anastas, P. T., and Warner, J. C.,.** *Principles of Green Chemistry. Green Chemistry: Theory and Practice.* New York : Oxford University Press, 1998.

[11] *Discovery Learning Model Using Green Chemistry Practicum to Improve Student Learning Outcomes.* **Merta, L, M.,.** 3, s.l. : Journal For Lesson And Learning Studies, 2020, Zv. 3.

[12] *Chemical Practice Guide Design Based on Natural Materials.* **Mastura, Mauliza, and Nurhafidhah.** 2, s.l. : ournal of Science and Science Learning, 2007, Zv. 1.

[13] *Feasibility Analysis of Chemistry Practicum Guide for Class XII Semester II Based on BSNP According to Curriculum 2013.* **Jusmasari, H., Novita, S., Salahuddin A. P., and Nuraini N.,.** s.l. : TALENTA Conference Series, 2019, Zv. 2.
[14] *Development of Guided Inquiry Green Chemistry.* **Ekin, A. K., Nurfajriani, Ramlan, S.,.** s.l. : The 4th Annual International Seminar on Transformative Education and Educational Leadership (AISTEEL), 2019.
[15] *Development Of Contextual-Based Practicum Guide for Integrated Character Values in Coloid System Materials.* **Manalu, E. T.,.** 1, s.l. : Quaerite Veritatem, 2021, Zv. 1.