Literature Review : Analysis Implementation of Worksheets Students in Green Chemistry Against Green Chemistry Principles for Students at SMAN 1 Jamblang

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ABSTRACT

Study This aiming For analyze Application of Worksheet Students (LKPD) in context learning chemistry green and its influence to understanding green chemistry principles at SMAN 1 Jamblang . With use literature review approach , articles This to study various studies previous about the role of LKPD in increase engagement and results Study students . Results of the analysis show that integrated implementation of LKPD with the principles of green chemistry are able increase understanding student to concepts sustainability and environment . Research This expected can give contribution positive for development method more learning effective in education chemistry as well as push sensitivity student to issues environment.

Keywords: Worksheet Students , Green Chemistry, Chemistry Education

INTRODUCTION

In the midst of today's modern era, i su environment be one of attention major worldwide . Various problem like pollution , change climate , and damage ecosystem the more day the more urge For overcome . In the context of this , develop more practical friendly environment be one of step important (Harris, 2019) , human activities such as industrialization and urbanization have had significant negative impacts on the environment to increase the need to strengthen environmental education, especially among the younger generation, who have a vital role in maintaining and improving the environment for the future.

Chemistry education is expected to contribute significantly to building environmental awareness. The principles of green chemistry, defined by Anastas and Warner (1998), offer an approach aimed at reducing the use and production of hazardous materials. Research by Khan and Shah (2020) shows that the application of green chemistry principles in education not only provides an understanding of environmental issues but also encourages changes in attitudes and behaviors that are more pro-environmental among students.

Chemistry education play a role important in to form awareness and understanding participant educate related problem environment . Moreover, the generation young must equipped with knowledge about principles chemistry green For understand the impact caused from activity conventional chemistry . This is in line with objective education national which emphasizes importance education based on environment (Directorate) General of Primary and Secondary Education , 2017).

Green Chemistry is increasingly popular Still Lots participant less educated understand principles said . Research shows that understanding participant educate about green chemistry still low , and things This can due to lack of integration relevant learning in curriculum (Meyer & Sokol, 2020). Therefore that 's important For create module learning that can increase understanding participant educate about chemistry green .

Learning module based on chemistry green expected can be one of solution in increase understanding participant educate . Interactive and applicable learning will more stimulate participant educate For understand concepts complex . Research conducted by Bayrak et al. (2021) shows that use module interactive in learning chemistry can increase results Study participant educate in a way significant .

Active and participatory learning methods , such as use module based on chemistry green , proven more effective compared to method traditional . This is because participant educate involved direct in the learning process , so increase motivation and understanding them (Tobias & Duffy, 2020). Through interesting learning media , participants educate more easy understand and internalize principles of green chemistry. In the context of this is important done analysis understanding participant educate to module learning that has been developed . Research This focus on understanding principles of green chemistry through compiled modules with approach curriculum based on competence . Through study this , it is expected there is clear picture about to what extent participants educate understand concepts in chemistry green .

Various studies have shown that the success of learning modules is highly dependent on the active involvement of students. Sambangi and Aydin (2021) stated that students who were actively involved in group discussions and research projects showed a significant increase in environmental awareness. In this way, education becomes not only a cognitive aspect but also an emotional one in raising a sense of concern for environmental issues. One method that has proven effective in teaching green chemistry is through practical experiences. Rojas and Morales (2020) highlighted the importance of laboratory activities designed to educate students about the principles of green chemistry. Through these activities, students can see firsthand the impact of each chemical used and more environmentally friendly alternative methods.

Every factor that influences green chemistry education should also be integrated into the curriculum design. In one objective from study This

is For give recommendation based on data that can used For design and implement more effective learning strategies good . It is expected with existence research this , educators can more understand How method build awareness and understanding participant educate to issues environment through module effective learning about chemistry green . With all existing challenges and potential , research This expected No only just answer anxiety learning chemistry moment this , but also provides road for generation young For become pioneer in create a better world clean and sustainable through application principles of green chemistry. With Thus , education chemistry No only will print scientists , but also concerned citizens to environment and committed For guard sustainability earth (Güler & Ogan- Bekiroğlu , 2020).

METHOD

Literature study is the method used in describe Analysis Implementation of Worksheets Students in Green Chemistry Against Green Chemistry Principles of Students at SMAN 1 JAMBLANG. In supporting idea study this , of course required study previous as amplifier argument done study this (Faiz, 2023). The sources taken in study This is a number of article from study previously in a number of year final with relevant research from journal national and international which discuss about Analysis Implementation of Worksheets Students in Green Chemistry Against Green Chemistry Principles for Students at SMAN 1 JAMBLANG. Steps study Literature study refers to the work of Nasution, (Yaswinda & Maulana 2019). Pitaloka et al., (2022) and Purwati et al., (2022) are as following :

For describe from results research that has been carried out and the discussion that will be carried out later withdrawn conclusion so researcher referring to the book (Sugiyono 2015) related method collecting data, reducing data, presenting data until drawing conclusions conclusion (Faiz 2023).

Types of Research

Study This use method literature review which was taken from a number of reputable journal relevant national and international related with title Study Analysis Implementation of Worksheets Students in Green Chemistry Against Green Chemistry Principles of Students at SMAN 1 JAMBLANG.

RESULT AND DISCUSSION

In the discussion of this research, the population and samples used in this study were 11 articles from journals indexed by Sinta with relevant research.

Table 1: Journal data taken for literature review

No	Journal Name	Number of Articles	Index Ranking
1	UNDIKSHA : Indonesian Journal of Chemical Education	1	Synta 2
2	Journal For Lesson and Learning Studies	1	Synta 2
3	Tambusai Education Journal	1	Sinta 5
4	ALLOTROPE : Journal of Education and Chemistry	1	Synta 4
5	Journal of Chemical Education Research	1	Synta 4

Table 2: Results of the analysis of the journals that have been taken

No	Author Name	Title Study	Research result
1.	Munifatun Muthoharoh , I Made Kirna, Gusti Ayu Indrawati	Implementation of Worksheets Multimedia - Based Student Worksheets (LKPD) for Increase Motivation and Chemistry Learning Outcomes	Research result show that the implementation of multimedia- based LKPD was successful increase motivation and results Study student in eye lesson Chemistry , Research This prove that the use of multimedia- based LKPD is not only increase understanding draft but also encourage motivation Study student in a way overall .
	Luh Maharani Merta	Learning model Invention Use Green Chemistry Lab For Improving Learning Outcomes Student	Research result show that application of learning models invention use practical work chemistry green can increase results Study student in a way significant . In the explanation more Next , a combination of learning models This No only increase results learning , but also having an impact positive on motivation Study students , interests learn , and skills think critical and creative.
	Febri Kurnia, Alizar Ulianas	Worksheet Development	Analysis results show Aiken's V average value is **0.85** ,

		Students (LKPD) Based on Project Based Learning on Green Chemistry Material Phase E SMA	which is located in valid category Percentage practicality by participants educate reach **88 %** , considered very practical.
	Cici Romayanti , Agus Sundaryono , Dewi Handayani	Development of Chemistry E-Module Based on Ability Thinking Creative with Use Kvisoft Flipbook Maker	Validation results from media experts show score **97.7 %** , temporary validation from expert material reach **90.2,** Test run readability in groups small (9 students) received percentage of 97.04%, which shows that e- module is very easy understood %.
5.	Nurbaity	Green Chemistry Approach A Innovation in Insightful Chemistry Learning Environment	Green chemistry plays a role important in education chemistry with offer approach innovative For reduce impact negative material chemistry to environment . Implementation principles of green chemistry in curriculum and practice laboratory can help create the next generation aware environmental and responsible answer to use material chemistry . Research This confirm the need integration principle chemistry green in education For support development sustainability and conservation environment .

LKPD based on Project Based Learning (PjBL) which was developed using the Plomp model declared valid with Aiken's V value average 0.85 (valid category) and practical with level practicality by students and teachers respectively 88% (very practical category). This LKPD help student understand material chemistry green through approach based on project , which involves exploration draft in a way independent and collaborative .

PjBL Model increase activity Study student with more pressure on the learning process interactive and student - centered , this LKPD solution become on lack teaching materials based on PjBL on material chemistry green in the Merdeka curriculum , especially in Phase E of SMA.

Learning model invention is a learning model that focuses activity learning to students , this model capable increase motivation Study students , interests learning , skills think critical , skills think creative , and results learning (Jamilah et al., 2017; Rahmadani et al., 2018; Sukmasari & Rosana, 2017). Improvement results study on the side caused by the application of the learning model discovery , also caused by the application of practical work chemistry green . Practicum chemistry green is practical work that uses ingredients friendly environment (Rizkiana et al., 2016; Saputro , 2016; Sumarti et al., 2018). Materials friendly the environment used this , besides safe for users (teachers and students), also friendly to environment . This means that the waste produced from ingredients friendly environment This No dangerous for creatures and the environment . Waste This can degraded with easily by microorganisms that exist in nature . Ingredients This can obtained with easy and affordable cheap . In addition , the practicum chemistry green This No need equipment special For do it .

This E-LKPD rated very worthy with test results one by one as big as 90.6% and group small as big as 88.8%, Project making fertilizer applied compost in e-LKPD the focus is on creativity participant educate , use indicator fluency , flexibility , and ability to elaborate

Use of e-LKPD based on PjBL This No only increase understanding student to principle chemistry green but also sharpen skills 21st century like creativity , Teachers provide response positive to the use of e -LKPD as tool help learning chemistry green .

Learning model PjBL on the material chemistry green show improvement results Study students . The post-test results showed that 13 students to obtain very good predicate , 10 students good , and 2 students Enough , Approach PjBL give experience learn more meaningful Because student involved direct in the learning process based on project . Learning This effective to improve learning outcomes and environmental awareness among students through the application of green chemistry principles.

CONCLUSION

Implementation of learning models based on green chemistry, such as Project Based Learning (PjBL), has been proven effective in increase results Study students . Research show that students involved in learning This show improvement significant in understanding concepts and skills think critical as well as creative they Approach this also works increase awareness student to issues environment . Students become more care to impact use material chemistry dangerous and more understand importance

practice friendly chemistry environment . This is reflected from attitude positive student to learning oriented towards green chemistry.

REFERENCES

Anastas, P. T., & Warner, J. C. (1998). *Green Chemistry: Theory and Practice* . Oxford University Press.

Amelia, DJ, & Saputra, SY (2017). Analysis Eligibility Book Student Class IV Living Things Theme 2013 Curriculum. Pedagogia : Journal of Education, 6(1), 98–109. https://doi.org/10.21070/pedagogia.v6i1.617. Ardithayasa , I.

Fitri , M., Yuanita , P., & Maimunah, M. (2020). Development Devices Learning Mathematics Integrated 21st Century Skills Through Implementation of Problem Based Learning (PBL) Model. Journal Gantang , 5(1), 77–85. https://doi.org/10.31629/jg.v5i1.1609

Kurnia, F., & Ulianas, A. (2023). Development of Worksheets Students (LKPD) Based on Project Based Learning on Green Chemistry Material Phase E SMA . *Tambusai Journal of Education* , 7(2), 9581–9589.

Ningsih, D. (2023). Development of e-LKPD Based on PjBL Making Fertilizer Compost on Green Chemistry Oriented Materials Creativity Learners Development of E-LKPD Based on Problem Based Learning on Green Chemistry Material . (2023).

Rojas, J., & Morales, M. (2020). "Impact of Green Chemistry Education on Students' Environmental Attitudes." *Journal of Chemical Education* , 97(4), 1156-1162.

Papageorgiou, V., & Noutsopoulos , C. (2018). "Integrating Green Chemistry into the Curriculum: A Pathway Towards Sustainable Chemistry Education." *International Journal of Environmental and Science Education* , 13(6), 2655-2669.

Purnama Sari, N. (2025). Development of E-LKPD with Project Based Learning Model Based on Chemo-Edutainment on Green Chemistry Material for Grade X of Senior High School . Jakarta: FITK UIN Syarif Hidayatullah Jakarta.

Sambangi , CK, & Aydin, S. (2021). "Effectiveness of Implementation of Green Chemistry Principles in Education: A Systematic Review." *Environmental Education Research* , 27(6), 789-804.

Li, X., & Liu, Y. (2021). "Green Chemistry Education: A New Perspective for Environmental Awareness in Higher Education." *Environmental Education Research* , 27(9), 1245-1260.

Yudiana , K. (2020). Group Investigation (GI) Learning Model Based on Tri Hita Karana on Science Learning Outcomes . Journal Scientific Elementary School , 4(2), 163–173. https://doi.org/10.238872Fjisd.v4i2.25105