STUDENTS' PERCEPTION OF ENVIRONMENTAL LITERACY THROUGH EDUCATION SUSTAINABLE DEVELOPMENT-ORIENTED CHEMISTRY LEARNING

Muhammad Al Gifary
Study Programme of Master of Science Education
Universitas Tadulako
Palu, Indonesia
algifari.argy@gmail.com

Ria Dzulhijjah
Study Programme of Master of Science Education
Universitas Tadulako
Palu, Indonesia
riadzulhijjah2@gmail.com

Emi Sulmeini
Study Programme of Master of Science Education
Universitas Tadulako
Palu, Indonesia
emisulmeini31@gmail.com

Daud K. Walanda
Study Programme of Master of Science Education
Universitas Tadulako
Palu, Indonesia
walanda@untad.ac.id

Mery Napitupulu
Study Programme of Master of Science Education
Universitas Tadulako
Palu, Indonesia
merytn@gmail.com

Ratman
Study Programme of Master of Science Education
Universitas Tadulako
Palu, Indonesia
ratman@untad.ac.id

Abstract— The concept of Sustainable Development Goals (SDGs) which have been issued by the United Nations (UN) become one of the solutions to overcome the environmental issue. In the concept of SDGs, there is one pillar, namely ESD (education sustainable development) which is an idea that comes from environmental education, so it is hoped that in the field of education, it will become the foundation of people's thinking patterns to understand environmental problems with their respective knowledge, especially chemistry. The aim of this study is to describe students' perceptions of environmental literacy through sustainable development-oriented chemistry learning. The method used was a survey method in which the questionnaire with 18 statements was distributed to the high school students. The research subjects were SMA, MA, and SMK students consisting of class X, XI, and XII totaling 100 respondents who were determined using the cluster sampling method. The results showed that the indicators consisted of knowledge 79.13% (good), attitude 83% (very good), skills 81.56% (very good), and behavior 85% (very good). Based on the results of this study, the general perception of students toward environmental literacy is very good.

Keywords— Students Perception, Environmental Literacy, Education Sustainable Development

I. INTRODUCTION

Nowadays, the development of technology is growing rapidly all over the world. The development of technology must be balanced with concern for the environment. The United Nations as the Organization that oversees the Nations made a commitment in the form of an agenda on the goals of Sustainable Development (SDGs). The SDGs are a commitment of each country to meet the challenges towards a sustainable world until 2030 [1]. The SDGs contain a set of agreed-upon transformative goals that apply to all nations without exception. The SDGs contain 17 Goals, including Quality Education. Where quality education is realized in the Education for sustainable development (ESD) agenda. ensure adequate and inclusive quality education and promote lifelong learning opportunities for all [2].

Education for sustainable development (ESD) is an idea that comes from environmental education [3]. Environmental education is the basis for preserving the environment which must be taught as early as possible through a curriculum that can be integrated with ESD. ESD must be integrated into all formal education curricula, including early childhood education, primary and secondary education, technical and vocational education and training, as well as higher education so that the values of sustainable development can be instilled in the younger generation through education.

Chemistry education is one of the fields of education that can contribute positively or negatively to sustainable development. Negative contribution if chemistry education in the learning process does not apply environmentally friendly principles so that every chemical process carried out will cause danger. Non-food hazardous chemicals such as bleach, cleaners, fragrances, and others can have a negative impact when exposed to direct exposure and can even cause mild irritation to damage to body tissues [4]. The positive contribution of chemistry education to sustainable development is the cultivation of concepts and applications in the form of practicum. Without inculcating the values of sustainable development, chemistry practicum can damage the environment [5].

Knowledge and awareness about the existence and scope of environmental problems are important because they can leverage awareness and concern for the environment. The emphasis should be on (i) knowledge of causes, (ii) knowledge of effects, and (iii) knowledge of strategies for change when faced with environmental problems. The dynamic relationship between humans and the environment can be seen in the coexistence of humans, side by side with all the components around them. The ability of each individual to behave well in everyday life by using his understanding of environmental conditions is called environmental literacy [6].

The concept of "Environmental Literacy" is used in environmental education which means that someone who understands the environment will know what and how to preserve the environment. In environmental literacy, a person's level of environmental literacy can be measured based on the criteria for the components of environmental literacy, namely: cognitive skills, attitudes, and environmentally responsible behavior [7]. In learning, it is not only the knowledge aspect that is emphasized but thinking, affective and behavioral abilities are also the main benchmarks for the success of environmental education programs, one of which can be measured by looking at student perceptions [8].

Perception can be defined as the process of giving meaning, and interpretation of stimuli and sensations received by individuals and is strongly influenced by internal and external factors of each individual [9]. The factors that influence a person's perception are as follows: (a) Internal factors: feelings, attitudes and individual characteristics, prejudices, desires or expectations, attention (focus), the learning process, physical condition, mental disorders, values and needs as well as interests, and motivation. (b) External factors: family background, information obtained, knowledge and needs around, intensity, size, opposition, repetition of motion, new and familiar things, or unfamiliarity of an object [10].

Based on the above background, this paper is intended to describe students' perceptions regarding environmental literacy in ESD-oriented chemistry learning.

II. METHOD

This study is descriptive research with a quantitative approach. According to Sugiyono [11], descriptive research is used to analyze data by describing or describing the data that has been collected as it is without intending to make conclusions that apply to the general public and generalizations. This study was designed in form of a survey using a structured questionnaire instrument. This survey research has the characteristic that the information collected comes from the sample with the aim of getting an overview of certain aspects or characteristics of the population from which the sample originates. In this study, the researcher did not give special treatment to the sample used, so it did not require a control class or an experimental class. This research was conducted in several SMA/MA/SMK in Parigi Moutong Regency, Central Sulawesi Province. This research was conducted for two months in the second term of the academic year.

A. Population and Sample

The population in this study were all active SMA/MA/SMK students in Parigi Moutong Regency, Central Sulawesi Province. While the sample in this study is part of the population that represents the population. The number of samples taken in this study was 100 students, using a cluster sampling technique. The use of this sampling technique is used because the distribution of the unit of analysis (samples) is wide and unidentified so the random technique at the cluster or group level is an effective and efficient way.

B. Sampling Technique

The sampling technique used to determine the respondents as a sample is multi-stage cluster sampling, namely random sampling in groups or clusters. Multi-stage cluster sampling technique is used to determine the sample if the object to be studied or the data source is very broad [11]. The sampling system with a cluster approach is carried out in three stages. The first stage is random sampling at the district level. Continued in the second stage with random sampling at the school level, followed by the third stage with random sampling at the class level, the sample used in this study were all selected class members. Based on the results of the sampling, the samples that represent the population are SMA, MA, and SMK students consisting of classes X, XI, and XII.

C. Data and Instrumentation

The data used in this study was primary data obtained through a questionnaire technique. The questionnaire consists of 18 statement items that represent 4 aspects of environmental literacy, namely: knowledge, cognitive skills, attitude, and environmentally responsible behavior [7]. The scale on the questionnaire used is a Likert scale with four alternative answer points [12]. This scale is made in the form of a statement so that it is followed by the respondent's choice which indicates the level. The response options on the scale are SD (Strongly Disagree), D (Disagree), A (Agree), and SA (Strongly Agree). The scoring of the answer choices on the Likert scale is SA = 4; A = 3; D = 2; SD = 1. The determination of this score refers to the literacy assessment process carried out by Amelia and Erlina [13].

III. RESULTS AND DISCUSSION

The results of this study include the results obtained during the process of filling out the environmental literacy questionnaire with the aim of seeing students' perceptions of environmental literacy in ESD-oriented Chemistry learning. The data obtained in this study is descriptive data with a quantitative approach. In the environmental literacy questionnaire, there are four indicators of environmental literacy, namely knowledge, skills, attitudes, and behavior. This research was conducted in SMA/MA/SMK in the Parigi Moutong area. Data retrieval using a questionnaire instrument made in the form of an online google form, then data processing using Microsoft Excel.

The results of this study were divided into four major topics, namely students' perceptions based on the type of school, students' perceptions based on grade origin, students' sources of knowledge about ESD, and student's level of understanding about ESD. This research was conducted in different schools where there are SMA, MA, and SMK and also with different grade levels, namely grades X, XI and XII.

A. Description of Environmental Literacy

Data on the results of students' perceptions of environmental literacy were obtained by giving a questionnaire which was analyzed based on the type of school and grade level. This is done to find out the comparison of SMA/MA/SMK and students of grade X/XI/XII. The results of environmental literacy research conducted on respondents based on school origin are presented in Table 1.

From Table 1, it is known that the score of research data on environmental literacy based on the type of school, obtained a total average score and this level of achievement shows the indicator categories in a row, namely knowledge "good", attitude "very good", skills "very good". " and "very good" behavior. For SMA, the indicator categories are "good" knowledge, "very good" attitude, "good" skills and "very good" behavior. For MA, the categories of indicators are "good" knowledge, "very good" attitude, "very good" skills and "very good" behavior. For SMK, the categories of indicators of knowledge are "good", attitude is "very good", skills are "very good" and behavior is "very good". It can be concluded that on average students from different schools have a very good concern for environmental literacy in chemistry learning.

TABLE I.   INDICATORS OF ENVIRONMENTAL LITERACY BY TYPE OF SCHOOL

INDICATOR	SMA			MA			SMK			Conclusion		
	Mean	TCR (%)	CATEGORY	Mean	TCR (%)	CATEGORY	Mean	TCR (%)	CATEGORY	Mean	TCR (%)	CATEGORY
Knowledge	3.19	79.78	Good	3.20	79.92	Good	3.11	77.65	Good	3.17	79.13	Good
Attitude	3.31	82.72	Very Good	3.31	82.77	Very Good	3.35	83.71	Very Good	3.32	83.06	Very Good
Skill	3.24	81.07	Good	3.27	81.82	Very Good	3.27	81.82	Very Good	3.26	81.56	Very Good
Behavior	3.42	85.42	Very Good	3.42	85.61	Very Good	3.42	85.48	Very Good	3.42	85.50	Very Good

TABLE II.   INDICATORS OF ENVIRONMENTAL LITERACY BY GRADE ORIGIN

INDICATOR	X			XI			XII			Conclusion		
	Mean	TCR (%)	CATEGORY	Mean	TCR (%)	CATEGORY	Mean	TCR (%)	CATEGORY	Mean	TCR (%)	CATEGORY
Knowledge	3.42	85.49	Very Good	3.09	77.21	Good	3.05	76.15	Good	3.18	79.63	Good
Attitude	3.52	87.95	Very Good	3.26	81.43	Good	3.24	80.92	Good	3.34	83.43	Very Good
Skill	3.45	86.16	Very Good	3.25	81.25	Good	3.14	78.45	Good	3.28	81.95	Very Good
Behavior	3.57	89.29	Very Good	3.35	83.70	Very Good	3.37	84.32	Very Good	3.43	85.77	Very Good

The results of environmental literacy research conducted on respondents based on grade origin are presented in Table 2. From table 2, it is known that the score of research data on environmental literacy based on grade origin obtained a total average score and this achievement level figure shows the indicator categories in a row, namely in "good" knowledge, "very good" attitude, "very good" skills and "very good" behavior. The environmental literacy category in class X is an indicator of "very good" knowledge, "very good" attitude, "very good" skills, and "very good" behavior. At the XI grade level, the indicator categories are "good" knowledge, "good" attitude, "good" skills, and "very good" behavior. Furthermore, for grade XII the indicator categories obtained are "good" knowledge, "very good" attitude, "very good" skills, and "very good" behavior. It can be concluded that on average students from various grade levels have a very good concern for environmental literacy in chemistry learning.

The results obtained for environmental literacy indicators based on the type of school origin and grade origin are students who have a very good concern for environmental literacy in chemistry learning. Learning in schools can affect the level of environmental literacy possessed by students as stated by Stoller-Patterson [14] is a process in which a person's environment is deliberately managed to allow participation in certain behaviors under special conditions or produce certain responses, learning is something that is most specifically in education. In another understanding, learning is an effort to teach students, learning is an effort to make students able to learn, need to learn, motivated to learn, willing to learn, and interested in continuing to learn something. That is why it is said that students' environmental literacy can be seen in the learning outcomes in schools.

There are several things that we should learn regarding this problem in perception, Mulyana [15] revealed the following: (a) perception is based on experience, and a person's behavior patterns are based on perceptions of social reality that he has learned (in the past). (b) perception is selective, for example in our senses, every time we are stimulated by millions of stimuli. If we have to give an interpretation of all these stimuli, then we can go crazy. Therefore, we are required to overcome these complexities by paying attention to the things that interest us. Our attention is basically the main factor in determining the selection of the stimuli that enter us. (c) Perception is conjectural because basically the data we get through sensing is never complete, so we often make assumptions or make inferences directly. Take a look at what pictures can be made with the following three dots and four dots. (d) perception is

evaluative in that many people assume that what they perceive is something real. That is, a person's feelings often affect his perception, even though it is not something objective. (e) perception is contextual, that is, from every communication event, a person is always required to organize stimuli into a perception. Perceiving other people's goals has several meanings for us in communicating. It is impossible for us to actually observe the internal state of others. But through observing his behavior, we can conclude how the attitudes, beliefs, and values of the person.

B. Description of ESD Knowledge

Education for Sustainable Development provides awareness and ability, especially for the younger generation, to actively contribute to the environment now and in the future. The introduction of ESD in schools, especially at the high school level (SMA and the Equivalent) can be done by inculcating the values of sustainable development through learning in schools, especially on the environmental dimension. One of the lessons at the high school/equivalent level is chemistry. The results of research on the level of student understanding conducted by respondents based on school origin and grade level are presented in Table 3.

TABLE III.   UNDERSTANDINGS THE LEVEL OF ESD

Understanding Level	Type of school				Class Origin			
	MA	SMA	SMK	Total	X	XI	XII	Total
Fairly understanding	9	11	9	**29**	13	10	6	**29**
reasonable understanding	3	5	4	**12**	2	4	6	**12**
very understanding	2	1	-	**3**	-	1	2	**3**
slightly understanding	15	14	14	**43**	10	15	18	**43**
not understanding	4	3	6	**13**	3	4	6	**13**

TABLE IV.   SOURCE OF INFORMATION ON ESD

Understanding Level	Type of school				Class Origin			
	MA	SMA	SMK	Total	X	XI	XII	Total
Artickel	4	5	2	**11**	3	6	2	**11**
Newspaper	1	-	-	**1**	-	1	-	**1**
Social Media	19	17	19	**55**	9	19	27	**55**
School Knowledge	7	11	10	**28**	15	6	7	**28**
Peers	2	1	2	**5**	1	2	2	**5**

Based on Table 3, it can be seen that students' understanding of ESD the lowest choice is 3 students understand very well whereas in MA there are 2 students, SMA 1 student, and SMK 0 students. Based on grade origin, X 0 students, XI 1 student, and XII 2 students. The highest choice is 43 students who understand a little whereas in MA there are 15 students, SMA 14 students, and SMK 14 students. Based on grade origin, for X 10 students, XI 15 students, and XII 18 students. This means that students' understanding of ESD is still lacking. This can happen due to a lack of students' understanding of ESD which is related to environmental aspects. So that a factor that can also cause students' lack of understanding about ESD is the lack of intention to know and study environmental problems. This is in line with previous research conducted by Rohweder [16] with the results of research stating that students' environmental literacy is still low due to several factors, one of which is the intention to know and study environmental problems.

The results of research on sources of information of ESD conducted on respondents based on the type of school and grade origin are presented in Table 4.

Based on Table 4 above, it can be seen that the way students know about ESD is through social media according to the type of school as many as 55 students, namely 19 SMA students, 19 SMK, and 17 MA students. Furthermore, students choose social media based on grade origin, namely as many as 55 students consisting of 27 grade XII students, 19 XI students, and 9 X students. This is related to the current advances in digital technology, which makes it easier to communicate and easy to find the information you need. According to Ainiyah [17] social media can also be referred to as online media where users can easily participate, share, and create content including blogs, social networks, wikis, forums, and cyberspace. Blogs and social networks are probably the most common forms of social media used by people today.

Furthermore, for students' sources of information, schools' knowledge based on school origins as many as 28 students, from 11 MA students, 10 SMK students, and 7 SMA students. Then the selection of schools knowledge as a source of information based on the grade origin of 28 students consisting of 15 students in grade X, 7 students in grade X, and 6 students in grade XI. Learning in schools develops students' personalities as a whole. The more important function of schools is actually to convey knowledge and carry out intelligent education. According to Purwanto [18] the function of the school in intellectual education can be equated with the function of the family in moral education. Improving intelligence, skills, and attitudes is an important capital for development. In addition, with a learning experience, all actions taken will be based on knowledge. This will make life quality.

Sources of information for students to gain knowledge are articles based on the type of school as many as 11 students, namely from 5 SMA students, 4 MA students, and 2 SMK. Next, students choose articles as a source of information according to grade origin with data consisting of 6 students in grade XI, 3 students in grade XII, and 2 students in grade X. The type of reference most often used by students to complete school assignments is in the form of scientific articles. Some students choose the type of reference such as scientific articles, of course, because a lot of information is clearer, easier to understand, more complete, and interesting. Most students do not choose articles as a source of knowledge because the language used in scientific articles contains terms that only apply to certain fields.

Furthermore, 5 students, namely 2 MA students, 2 SMK students, and 1 SMA student chose peers as a source of information. Furthermore, students choose peers as a source of information according to class level consisting of 2 students in grade XI, 2 students in grade XII, and 1 student in grade X. Peer environment is one of the external social factors that affect the knowledge of these students. According to Santrock [19] peers are children or adolescents who have the same age and level of maturity. The main function of peers is to provide a source of information and comparison about the world outside the family, so that poor peer relationships can lead children to bad behavior and vice versa.

The least chosen source of information was newspapers, only 1 MA student in grade XI chose print media as a source of information. This is because the newspaper is very less attractive to readers among students. The presence of the internet makes access to information easier, and faster to obtain than newspapers. According to Watie [20] communication in newspapers runs only in one direction, in the sense that media connoisseurs can only enjoy the content presented by media sources. But along with the times, ordinary people as media connoisseurs can no longer only enjoy content from media that are infected with them, but can already participate in filling out content in the media.

According to the majority of respondents, ESD is needed in chemistry education because chemistry education is faced with the challenge of preparing young people who are competent and actively contribute to society. Students need to be prepared with competence and problem-solving skills related to social, environmental, and sustainable development issues. Students as part of the next generation are expected to learn chemistry that is sustainable and environmentally friendly. Thus, green chemistry should be introduced to students as early as possible. Students are guided to raise awareness of and importance of sustainable strategies in chemical research [21].

IV. CONCLUSION

The results showed that the indicators consisted of knowledge 79.13% (good), attitude 83% (very good), skills 81.56% (very good), and behavior 85% (very good). Sources of information about ESD are dominated by social media, while the level of students' understanding of ESD is a little understanding. Based on the results of the study, the general perception of students toward environmental literacy is very good.

ACKNOWLEDGMENT

REFERENCES

[1] Siraj-Blatchford J, 2009 Education for sustainable development in early childhood *International Journal of Early Childhood* **41**, 2 pp. 9–22.

[2] Organization W H, 2015 Health in 2015: from MDGs, millennium development goals to SDGs, sustainable development goals.

[3] Segara N B, 2015 Education for sustainable development (ESD) sebuah upaya mewujudkan kelestarian lingkungan *SOSIO-DIDAKTIKA: Social Science Education Journal* **2**, 1 pp. 22–30.

[4] Peraturan Menteri Kesehatan, 1996 *Pengamanan Bahan Berbahaya Bagi Kesehatan* Indonesia.

[5] Al Idrus S W Purwoko A A Hadisaputra S and Junaidi E, Dec. 2020 Pengembangan Modul Praktikum Kimia Lingkungan Berbasis Green Chemistry Pada Mata Kuliah Kimia Lngkungan *Jurnal Pijar Mipa* **15**, 5. pp. 541-547

[6] Syakur A, 2017 Education For Sustainable Development (ESD) Sebagai Respon dari Isu Tantangan Global Melalui Pendidikan Berkarakter dan Berwawasan Lingkungan yang Diterapkan pada Sekolah Dasar, Sekolah Menengah dan Kejuruan di Kota Malang *Eduscience* **1**, 1 pp. 37–47.

[7] North American Association for Environmental Education (NAAEE)., 2011, National Environmental Literacy Assessment, Phase Two: Measuring the Effectiveness of North American Environmental Education Programs with Respect to the Parameters of Environmental Literacy, Washington.

[8] Saribas D, 2015 Investigating the Relationship between Pre-Service Teachers' Scientific Literacy, Environmental Literacy and Life-Long Learning Tendency. *Science Education International* **26**, 1 pp. 80–100.

[9] Arifin H S Fuady I and Kuswarno E, 2017 Factor Analysis That Effect University Student Perception in Untirta About Existence Of Region Regulation In Serang City *Jurnal Penelitian Komunikasi Dan Opini Publik* **21**, 1. Pp. 1-6

[10] Thoha M, 2014 Organisasi Konsep Dasar dan Aplikasinya *Jakarta: PT Grafindo Persada*.

[11] Sugiyono, 2009 Metode Penelitian Kuantitatif, Kualitatif, dan R&D, Bandung: Alfabeta .

[12] Creswell J W, 2012, Educational research: Planning conducting and evaluating quantitative and qualitative research (4th ad.). Boston, MA.

[13] Amelia T and Erlina E, 2017 Profil literasi kemaritiman guru biologi dalam pembelajaran ipa smp negeri di kabupaten bintan *Jurnal Kiprah* **5**, 1 pp. 7–13.

[14] Stoller-Patterson A L, 2012 Educating for Environmental Literacy in America's Public Schools.

[15] Mulyana D, 2000 *Ilmu Komunikasi Suatu Pengantar* Bandung: Remaja Rosda Karja.

[16] Rohweder L, 2004, Integrating environmental education into business schools' educational plans in Finland.

[17] Ainiyah N, 2018 Remaja Millenial dan Media Sosial: Media Sosial Sebagai Media Informasi Pendidikan Bagi Remaja Millenial *Jurnal Pendidikan Islam Indonesia* **2**, 2 pp. 221–236.

[18] Purwanto N, 2014 pengantar Pendidikan *Yogyakarta: Graha Ilmu*.

[19] Santrock J W, 2009 *Psikologi Pendidikan* Jakarta: Salemba Humanika.

[20] Watie E D S, 2016 Komunikasi dan media sosial (communications and social media) *Jurnal The Messenger* **3**, 2 pp. 69–74.

[21] Listyarini R V, 2019 Mempromosikan keberlanjutan dalam program s1: persepsi siswa dalam kursus kimia hijau Jurnal Internasional Pendidikan dan Pengajaran Indonesia 3, 1 pp. 2548–8422.