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Exploring Senior High School Students' Social Representation of Biodiversity

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Abstract—*It is imperative that learners are aware of what is happening in the environment. They should understand how living and non-living things interact with one another as well as their similarities and differences. In the process, they will be able to appreciate nature and lead to deeper understanding of biodiversity concepts. Through context analysis, this qualitative study explored the Senior High School students' social representations of biodiversity. Students were asked to give three definitions on what biodiversity is. Themes were generated based on public's biodiversity social representations with the following components: (1) functions and benefits associated with biodiversity; (2) attributes and values connected to nature; (3) views on the relationships between humans and nature. It was found that the students focused more on the attributes connected to nature; followed by the functions and benefits associated with biodiversity and lastly their views on the relationships between humans and nature. Likewise, Senior High School students have a narrow concept of biodiversity in terms of the relationships between humans and nature and its aesthetic value; thus, sample active learning strategies are being forwarded.*

Keywords—*Biodiversity; Senior High School student; social representation*

I. INTRODUCTION

It is imperative that learners are aware of what is happening in the environment. They should understand how living and nonliving things interact with one another as well as their similarities and differences. In the process, they will be able to appreciate nature and lead to deeper understanding of biodiversity concepts. This is the reason why at an early age, the concept of biodiversity should be taught and experienced by the learners (Hellden & Hellden, 2012). They added that if students will be taught to become lifelong learners and everyone likes to have a sustainable future, early ideas on this topic should be considered.

With the present condition of the planet Earth where environmental degradation abounds, the biodiversity crisis is one of the most severe problems the world is facing right now. UNESCO (2019) emphasized that people should act responsibly since what they do can have implications on their lives and the future of the planet. Education for Sustainable Development (ESD) empowers people to change the way they think and work towards a sustainable future.

Analyzing the situation above, it is necessary to investigate the problems concerning biodiversity in nature. Biodiversity has been defined in the convention on Biological Diversity, signed by 154 nations at the Rio Summit as the "variability among living organisms from all sources including inter aerial, terrestrial, marine, and other aquatic ecosystems and the ecological diversity: this includes diversity within species, between species and of ecosystems (UNEP, 1993 as cited by Hanley, et al., 1995). However, environmental degradation happens everywhere in the world and awareness alone cannot resolve these problems leading to extinction of species.

The implementation of the K to 12 Basic Education Law in the Philippines is one way by which the country responded to biodiversity problems by integrating this topic in the Science curriculum. This law emphasizes that Science education aims to develop scientific literacy among learners that will prepare them to be informed and participative citizens who are able to make judgments and decisions regarding applications of scientific knowledge that may have social, health or environmental impacts. This is further emphasized in the Core Learning Area Standard in Science for the entire K to 12, which is "the learners demonstrated understanding of basic science concepts and application of science – inquiry skills." Students exhibit scientific attitudes and values to solve problems critically, innovate beneficial products to protect the environment and conserve resources, enhance the integrity and wellness of people, make informed decisions, and engage in discussions of relevant problems that involve science, technology, and environment.

Perceptions of various groups of scientists or experts and lay people on biodiversity had been conducted. One of these studies was conducted by Arjen (2008) who found that experts and lay people attached different meanings on what biodiversity is all about. Thus, this study was conducted among Senior High School (SHS) students who are required to enroll in a Life Science subject to acquire a better understanding of the ecosystem and biodiversity although they have background knowledge on these topics since they were in the elementary level. Teachers trained the SHS on how to take care of the environment of whom Jiwa & Essa (2015) referred to as the teachers exert greater influence in the formation of the citizens and its integration in the curriculum. However, it remains that biodiversity is an abstract concept; attracting various responses from different people according to where they have come from and what ecosystems they have been closely linked to (Zermitz, 2006). Welie & Wals (2002) as cited by Motakane (2017) explained that biodiversity is an ill-defined concept that is impossible to be explained by a simple definition. They explained that this topic can be understood in various means and is challenging to define operationally.

SHS students are expected to have a better understanding of the topic since they are interacting with the environment every day and they benefit from its products. It is necessary

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that they are aware of how diverse the environment surrounding them is. With better understanding of the surroundings and the organisms present, students will be able to take care and protect them.

To determine SHS students' concepts and understanding of biodiversity as one group of the society, their social representations were gathered. Wagner, et al. (1999) as cited by Arjen (2008) described social representations as socially constructed; it is likewise facilitating communication by presenting a commonly shared set of representations needed to understand the signs people attach to concepts and objects. Mouro & Castro (2016) added that social representation looks at how individuals, in this case the SHS students, elaborate new representations related to biodiversity conservation in their local community and with the legal sphere. The explanations cited are the reasons why SHS students' social representations of biodiversity will be determined.

As the United Nations designated 2011 – 2020 as the UN Decade on Biodiversity and in support to the environmental projects of De La Salle Lipa towards sustainability, this study explored the Senior High School students' social representations of biodiversity through content analysis based on Bujis, et al. (2009) study on social representations of nature and local practices with three major components of biodiversity representations such as views on the functions and benefits that biodiversity might provide; attributes associated with nature; and, views on the relationship between humankind and nature. This study is also in support with the findings of Navarro – Perez & Tidball (2012) that the four major challenges of biology education are: the need to describe an approach for biology education, biodiversity as an ill - defined concept, correct communication and the disconnection between people and nature. Motakane (2017) added that biodiversity is a multifaceted concept in science, and it is very difficult to teach in school. Mouro and Castro (2018) recommended that it is at the local level that biodiversity loss can be stopped, which current literature has focused mainly on the conflicts between the legal and local spheres without paying attention to the local dynamics in the response to biodiversity laws. After determining the SHS students' social representations of biodiversity, sample active learning strategies are proposed for the students to understand biodiversity concepts that will help them engage in protecting and managing the Earth's diverse environment. It is also worthy to note that biodiversity is a new issue in educational research and formal education and there is significant decline in the people's understanding of biodiversity during the past few decades (Yli – Panula, et al., 2018).

This study is anchored on the work of Bujis, et al. (2009) in which three major components of biodiversity representations had been identified such as views on the functions and benefits that biodiversity might provide; attributes associated with nature; and views on the relationship between humankind and nature.

II. METHODOLOGY

A. Research Design

The qualitative method of research was used in this study through content analysis technique to determine the SHS students' social representations of biodiversity by categorizing the text from the questionnaire. Codes have been already identified using the three major components of biodiversity representations by Bujis, et al. (2009).

B. Participants of the Study

Four hundred Grade 11 SHS students – ABM strand of a private school enrolled in the subject Life Science, were expected to participate in this study. However, not all students responded based on the retrieval of the informed consent. The latter were chosen because all of them have acquired background knowledge on the topic biodiversity and these students are Science majors.

C. Source of Data

A questionnaire with only one (1) question "*What are the three things that come to your mind on the word biodiversity?"* was distributed among Grade 11 students to determine their social representations of biodiversity. The identified key issues and themes became the bases of sorting of qualitative data from the open – ended questionnaire.

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F. Informed Consent

Before the conduct of the study, a letter of consent was sent to the parents of the respondents who were asked and consented to be part of this study. They were informed that their son's or daughter's participation is voluntary, no known risks if he or she will decide to join and will not cost him or her anything. It was also emphasized that the information gathered were solely for the conduct of this study and no individual information will be disclosed.

G. Data Gathering Procedures

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H. Data Analysis

In processing and analyzing data, the first step is transcription of words from SHS students' answers in the open – ended questionnaire. Then, familiarization with the answers followed. Coding was done to label or put code on the line or passage that best describes SHS students' views. Developing a working analytical framework analysis through tabulation followed in lines or passages were grouped according to themes or components identified by Buijs, et al. (2009).

Thematic anchoring was used in the analysis of data through the underlying categories of meanings identified in the study. The data gathered were compared with the components along with their corresponding sub – components and their descriptions of social representation on Biodiversity. According to Moscovici (2000; 2001) as cited by Hoijer (2011), the concept of theme is to catch the structural in-depth levels of social representations. He argues that underlying collective, general patterns of thinking or primary ideas is in interplay with specific contexts that generates and structures new social representations. Likewise, frequencies were shown in the table to indicate the greatest number of responses. The frequencies also became the bases for determining the focus of the proposed sample active learning strategies as outputs of this study. These strategies are anchored on the constructivist framework as emphasized in the K to 12 Law of the Philippines.

III. Results and Discussion

Table 1 shows that SHS students define biodiversity based on one of its components of social representation, which is functions and benefits people get from biodiversity. These findings agreed with the framework of Bugis, et al. (2009). However, it is noted that SHS students identified three out of four sub – components of the component such as basis of human life, providing and ensuring balance and economic values. No one defined or described biodiversity in terms of its aesthetic functions.

TABLE I. Views of SHS Students on the Functions and Benefits that Biodiversity Can Provide.

Component	Sub-Component	Sample Responses with Frequencies
Functions and benefits that biodiversity can provide	1. Basis of human life	- support human life (42) - provide basic needs (39) -foundation of ecosystem services for humans to survive (21)
		- important in the life cycle, food cycle and biological processes (33) - organisms have important role in the ecosystem (25)
	2. providing and ensuring balance	- ensures sustainability of all species (23) - aids in maintaining ecological relationships (19) - connects and associates organisms (14) - foundations of ecosystem (7)
	3. aesthetic values	- no answer
	4. economic values	- provides basic goods and services to reduce poverty (27) - for economic development (19)

It was also found that SHS students represented biodiversity as something that provides and ensure balance. Here are some of examples of the students' responses: *"to provide and ensure balance, life cycle, food cycle and biological processes are important"*.

SHS students also stated, *"organisms have important role in the ecosystem"*. Others describe biodiversity that it *"ensures sustainability of all species".* Some students defined biodiversity as something that *aids in maintaining ecological relationships*. It *"connects and associates organisms".* It is the "*foundation of ecosystem".*

It was also found that SHS students defined biodiversity as basis of human life. They stated that *"biodiversity support human life*". It is the "*foundation of immeasurable array of ecosystem services for human survival"*. For others, *"biodiversity provides basic needs of man"*.

Very few SHS students defined biodiversity in terms of economic values. This claim is supported by these statements: *"biodiversity offers basic goods and services to lessen poverty"*; and *"it is indispensable for economic development".*

The statements of Yli – Panula et al. (2018) support the above findings that students and teachers do not understand what really biodiversity means and what it includes. In relation to this study, they failed to give their ideas on the aesthetic value of biodiversity and few of them defined or described biodiversity in terms of economic values. The study of Jiwa & Esa (2015) showed that their respondents are familiar with the concept of biodiversity and give its definition very briefly; similar with the definitions and descriptions given by the SHS students. In addition, the findings of this study is congruent with the results of the study conducted by Yli - Panula, et al. (2018) that 90% of student teachers are able to define biodiversity; however, their definition is not very much congruent to the definition provided by the Convention on Biological Diversity; that is, biodiversity is the variability among living organisms from all sources including inter aerial, terrestrial, marine and other aquatic ecosystems and the ecological diversity which these are a part: this includes diversity within species, between species and of ecosystems. These definitions are very explicit in Table 1.

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TABLE 2. SHS Students' Views on the Attributes Associated with Nature

Component	Sub-Component	Sample Responses with Frequencies
Characteristics associated to nature.	1. vitality	- life (193) - every living thing around us (186) - life on Earth or in the world (181) - different forms of life (164) - different species (153) - variety of life (148) - variety of plants and animals (140) - variety and variability of life (133) - variability of life (127) - diversity of life (122) - biological diversity (116) - community (92) -comprises different genetic, species and ecological levels (80)
	2. autarky	- each species has important role to play (34) - livings things differ from one another (27) - different forms of life (21) - diversity within species and genetic make – up (16) - uniqueness of each organism (14)
	3. diversity	- huge variety of animals and plants (64) - large variety of species on Earth (59) - vastness of life (56) -availability and presence of different species (54) - classifications of life (53) - made – up of several levels of life (48) - interaction among organisms (47) - relationships among organisms (42) -different species in harmonious relationship in an ecosystem (44) -diverse collection of organisms (41) - number of different species within an environment (38) - connection between and among living things (31) - ecosystem and how it works (25) - coexistence among organisms - existence of organisms (23) - occurrence of different types of ecosystem (21) - complex and vital feature of a planet (16) - how organisms live and their habitat (15) - intricate balance in an ecosystem (8)
	4. balance	- relation of species and environment (48) - presence of different organisms or life forms (47) - presence of different ecosystems (43) - diversity in an ecosystem (40) - existence of life (39) - sustenance of life (35) - living things that live together in a particular habitat (31) - way of life of organisms in their environment (28) - unity and diversity among organisms (27) - habitat whether terrestrial, aquatic and aerial (24) - ecological relationships (21) - balanced ecosystem (17) - habitats of organisms (14) - ability of organisms to adopt in a diverse environment (9) - community (6)
	5. robustness vs. fragility	- abundance of life forms that may affect one another (52) - organisms are not distributed evenly on Earth (46) - different organisms existing in a certain place living in a sustainable way (27) - all living and non – living things contribute to ecological balance (21) - the more the species, the more diverse the ecosystem is; the lesser the species, the less diverse the ecosystem (12) - affected by heredity and environment (8) - environment is evolving (6) - evolution has brought diverse genetic life on Earth (3) - climate change affects biodiversity (2)
	6. stasis vs dynamics	- uniqueness and differences between organisms because of evolution (41) -different species in a particular habitat that has an impact in the world (38) - rapid environmental changes can decrease biodiversity (30) - evolving and interconnected social and biological dimensions of life (28) - dynamic (13)

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Table 2 shows that SHS students defined biodiversity based on one of the components of social representation of biodiversity which is attributes of nature. These findings agreed with the framework of Bugis, et al. (2009). Likewise, all the six sub – components of attributes of nature had been emphasized by the SHS students.

Among the six sub – components, many expressed their social representations of biodiversity based on the origin of the word which is "diversity". They defined the word in terms of variability as evident in these statements: *"availability and presence of different species"* and *"varied collection of organisms".* Others defined it in terms of numbers such as: *"number of different species within an environment"; "huge variety of animals and plants"; "large variety of species on Earth"*; and *"vastness of life".* There were SHS students who defined biodiversity in terms of classifications and levels of life. Another definition given is in terms of relationships existing among diverse organisms as evident in the following statements: *"different species in harmonious relationship",* "*variability among living organisms from all sources including inter aerial, terrestrial, marine and other aquatic ecosystems and the ecological diversity which these are a part: this includes diversity within species, between species and of relationship in an ecosystem; "ecosystems and how it works"; "interaction among organisms; among organisms"; "connection between and among living things"; "coexistence among organisms"; "existence of organisms"; "occurrence of different types of ecosystem"; "complex and vital feature of a planet"; "intricate balance in an ecosystem"*; and, *"how organisms live and their habitat".* With the many definitions given about biodiversity, it seems that SHS students are very familiar with the word itself since biodiversity had been studied since they were in the elementary level.

The above answers of the SHS students are congruent with the formal statement of the Convention on Biological Diversity in 1992, where Biodiversity was defined as "the variability among living organisms from all sources including aerial, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part of: this includes diversity within species, between species and of ecosystems" (Yli – Panula, et al., 2018). On the other hand, these findings contradicted with the results of the study conducted by Jiwa and Esa (2015) that students can give definition of what biodiversity is all about but were not able to explain in more a detailed way. According to Bermudez & Lindermann – Matthies (2018), present-day understanding of biodiversity includes other components, such as the number, abundance, composition, and spatial distribution of species and functional groups.

Looking at Table 2, autarky as a component of attributes of nature is the least to be defined. According to Bujis, et al. (2009), autarky refers to self – sufficiency, of nature being independent, untouched by humans, unpredictable or imposing. The following were the definitions of SHS students of biodiversity based on autarky: *"living things are different from one another"; "different forms of life*"; "diversity within species and genetic make – up"; and *"uniqueness of each organism".* This is evident during discussion in any Biology or Environmental Science class that when students are asked on the definitions or descriptions of biodiversity, they always give the etymology of the word, which is *bio* (life) and *diversity* (different).

Jiwa & Esa (2015) shared that in a survey of 125 students at the University of Stirling, United Kingdom, respondents frequently state the terms species, biologists, vegetation, and diversity in terms of biodiversity thus, showing a lack of understanding on what biodiversity is all about. However, the same author explained that part of the definition is the inclusion of diversity within species, between species and of ecosystems; thus, biodiversity may be considered at three levels which is genetic diversity, species diversity and ecosystem diversity and this definition had been given by the SHS students under the sub – category of autarky found in Table 2.

TABLE 3. SHS Students' Views on the Relationship between Humankind and Nature.

Component	Sub-Component	Sample Responses with Frequencies
Relationship between humankind and nature	Humans as part of nature	- humans co-exist with other organisms in an ecosystem (13) - every human being has a role to play to maintain balance in the ecosystem (12) -humans are important in human – managed as well as natural ecosystem (8) - humans are important in managing natural resources (3)
	Humans as separate from nature	- environment must be considered by many as precious and must be preserved (8) - man must cooperate and join hands in taking care of the environment (5) - man must protect Mother Nature (5) - humans should realize that that different organism and their non – living counterparts should live in harmony with one another (2) - humans should ensure longevity of life (1)
	Humans as enemies of nature	- no answer
	Humans as users and engineers	- humans benefit from the environment through the air we breathe, the water we drink and the food we eat (2)

Table 3 shows that SHS students also defined biodiversity based on one of the components of social representation of biodiversity which is views on the relationship between humankind and nature. These findings agreed with the framework of Bujis, et al. (2009), which has two sub – components such as humans as part of nature and humans as

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separate from nature by the SHS students. These two subs – components were also evident in the definitions given and had been found that there were more definitions that focused on humans as separate from nature.

In the analysis of these data, it was found that the definitions fell under two categories such as: humans as stewards proven in the following statements: *"environment must be considered by many as precious and must be preserved"; "man must cooperate and join hands in taking care of the environment"; "man must protect Mother Nature"; "humans should realize that that different organisms and their non – living counterparts should live in harmony with one another";* and, *"humans should ensure longevity of life".* On the one hand, there were definitions that fell under the category humans as users and engineers: *"humans benefit from the environment through the air we breathe, the water we drink and the food we eat".* No definitions were given on the third description, which is humans as enemy.

For humans as part of nature, SHS students' social representations of biodiversity focused more on humans as participants as evident in the following statements that: *"humans coexist with other organisms in an ecosystem";* and *"every human being has a role to play to maintain balance in the ecosystem".* Students also gave definition on humans as responsible managers as evident in the following statements: *"humans are important in human – managed as well as natural ecosystem";* and *"humans are important in managing natural resources".*

It can be noted that there were few definitions under this component because most of the definitions given were based on what they had read from the books and learned from the class discussion. Another factor to consider is that the subject Earth and Life Science is a lecture subject. Alred (2016) supported this observation by explaining that in the absence of a meaningful connection or relation on this topic, learners cannot see its value or importance to their lives. Likewise, Welie & Wals (2002) as cited by Motakane (2017) explained that biodiversity is an ill-defined concept that cannot be captured by single or universally applicable definitions, can be interpreted in countless ways and is hard to define operationally.

To summarize, SHS students' social representations of biodiversity were based on the work of Bujis, et al. (2009) in which they had identified the three major components of biodiversity representations such as views on the functions and benefits that biodiversity might provide; attributes associated with nature; and views on the relationship between humankind and nature. However, SHS students' social representations focused more on the attributes connected to nature This is evident in the frequencies and range of their answers that they just defined or described biodiversity as variation of life forms or variety of life forms; different organisms around us such as plants and animals as well as the non – living things around them. They did not mention any values associated with nature. These findings support the statement in an article on Conserve Energy, Future, Be Green, Stay Green (2016) that biodiversity is described as a variety of living beings on earth. However, students have a very shallow concept of biodiversity because they cannot link the topic on their experiential level.

SHS students' social representations of biodiversity were also based on the functions and benefits that biodiversity might provide such as biodiversity as the basis of human life, providing and ensuring balance and economic values. No one defined or described biodiversity in terms of aesthetic values.

Limited answers were classified on the relationships between humans and nature when they hear the word biodiversity. Likewise, no one described the aesthetic value of biodiversity since classroom discussions focus more on knowledge level. This is evident in the contents of the K to 12 curriculum in which learning competencies on these aspects are missing. Students were not given the opportunity to acquire first-hand experience on the relationships between humans and nature and appreciate its aesthetic values. This affirms the statements of Huang and Lin (2014) that it is imperative to make connections between cognitive and affective dimensions of student learning. Affective dimension is the fuel that students bring to the classroom, connecting them to the why of learning. In addition, Zermitz (2006) explained that biodiversity is an abstract concept; attracting different responses from people according to where they have come from and what ecosystems they have been closely linked to.

Compared to the work of Bujis, et al. (2009), SHS students' social representations of biodiversity focused more on the attributes connected to nature. Thus, sample active learning strategies are being forwarded to strengthen SHS students' understanding of biodiversity specifically on the relationships between humans and nature and its aesthetic values.

IV. Conclusion

Senior High School students' social representations of biodiversity focused more on attributes associated with nature. Limited definitions were classified on its functions and benefits as well as on the relationships between humans and nature. No one also emphasized the aesthetic value of biodiversity since classroom discussions focus more on knowledge level. Likewise, learning competencies on these aspects are wanting in the K to 12 curriculum to give SHS students the opportunity to acquire first-hand experience on the relationships between humans and nature and appreciate its aesthetic values. Thus, connections between cognitive and affective dimensions of student learning on biodiversity should be established so that students fully understand the concept and engage them in activities related to environmental protection and conservation towards sustainability. Sample active learning strategies are being forwarded to strengthen SHS students' understanding of biodiversity specifically on the relationships between humans and nature and its aesthetic values.

V. Recommendations

It is recommended that an assessment be conducted first on SHS students' social representations of biodiversity so that this can be a basis for enhancing the teaching – learning

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process in the subject Earth and Life Science. Likewise, the proposed sample active learning strategies can be used to strengthen SHS students' understanding of biodiversity.

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