Advances in Engineering Research, volume 196
International Joint Conference on Science and Engineering (IJCSE 2020)

Tomini Bay as a Source of Chemistry Learning

Sandy A. Kusumah[1,*] Sri Atun[2] Hari Sutrisno[2]

[1] *Department of Educational Science, Graduate School, Yogyakarta State University, Yogyakarta, Indonesia*
[2] *Faculty of Mathematics and Natural Sciences, Yogyakarta State University, Yogyakarta, Indonesia*
[*] *Corresponding author. Email: sandy.abdi2015@student.uny.ac.id*

ABSTRACT
This study aims to identify the potential of Tomini Bay resources that can be utilized as a source of chemistry learning. This is a qualitative research using primary data and secondary data. Data collection were conducted through the combination of field research and literature studies. All data were analyzed using qualitative descriptive to analyze the potential of coastal and sea resources of Tomini Bay, which closely related to senior high school chemistry learning. The results showed the potential resources of Tomini Bay in general include water, fisheries and marine cultivation, coral reefs and sea biota, mangrove forests, coastal plants, plantations, conservation and recreation areas, and mining. This potential can be used as a source of learning chemistry in thirteen materials. There is the scientific method, the essence and role of chemistry in life; chemical bonding and molecular structure; electrolyte and nonelectrolyte solutions; reduction and oxidation reactions; reaction rates; chemical equilibrium; acids and bases; colligative properties of solutions; period 4 transition elements and their compounds; macromolecules (polymers, carbohydrates, and proteins); lipids; hydrocarbons and petroleum; and colloidal systems. From the results of the study, it can be concluded that Tomini Bay resources can be used as a source of chemistry learning which is a promising choice for studying chemistry.

Keywords: *Chemistry, Learning, Coastal, Sea, Maritime, Potential, Resources, Tomini Bay*

1. INTRODUCTION

Indonesia is the largest archipelago country in the world, and is known as a maritime country with the second longest coastline after Canada [1-2]. The sea area plus Indonesia's exclusive economic zone makes three quarters of its territory covered by sea. This makes Indonesia a nautical country that has a wealth of utilized coastal and sea resources optimally for the welfare of the people's lives. Indonesia has great potential, from coastal and sea resources to its strategic location. Therefore, one of the government's mission is to make Indonesia become an independent archipelago, advanced, strong and based on national interests.

Tomini Bay is the largest bay in Indonesia with a rich and unique coastal and sea resource potential. However, the local coastal communities in the bay are not able to properly manage natural resources in their area. This is because there are still many coastal communities who have low levels of education [3]. In addition, the condition of Tomini Bay as well as other areas in Indonesia which are rich in coastal and sea resources is currently facing the threat of degradation and environmental damage [4]. Damage to coral reefs due to the use of fish bombs and reduction of mangrove forests due to logging for firewood and industrial materials, or converted into ponds are some examples of damage that is easily encountered along the shores of Tomini Bay. Increasing the quality of coastal communities will greatly affect the use of natural resources offered by coastal and sea areas. The role of knowledge, skills and awareness of coastal communities can be increased in managing and protecting natural resources around them through education. Because, this knowledge can be obtained by the community from the education they already have. Sontay et al. (2015) expressed the importance of knowing the relationship between environmental knowledge, environmental impact and environmental behavior in the learning process [5]. This is expected to stem the behavior of society in damaging its environment.

In 2015 the government held an international Sail Tomini 2015 event which aims to create a new economic area. This must be supported by improving the quality of human resources. The quality of the maritime community will greatly affect the use of resources offered by coastal and sea areas. Coastal communities must have the knowledge and awareness to manage and protect their resources. Knowledge, skills, and awareness of coastal communities can be increased through education. This is because scientific knowledge and potential local resources can be linked effectively [6]. Moreover, at this time the potential use of Tomini Bay resources as a learning resource has not been optimized while

maintaining the environment in the science learning process, especially chemistry.

Chemistry is one of the branches of science that learns about the phenomena that exist in nature and life. Sirhan (2007) describes chemistry as the most important science that allows students to understand what is happening around them [7]. Understanding chemistry is a way to explain the phenomena in the surrounding environment, this is due to the study of chemistry that is not detached from life. The study of chemistry related to the environment and life includes the material structure, composition, properties, changes and the energy involved in the change. Fang et al. (2016) expressed the importance of teaching for conceptual understanding in science education [8]. The conceptual linkage learned by the side of the relevant field of science studies will form a cognitive scheme, so that students acquire the integral of knowledge. Therefore, a challenge for teachers to be able to teach chemistry is as much as possible in shaping and improving student knowledge.

As long as it develops the perception that chemistry is often regarded as a difficult lesson that sometimes makes learners fret to study chemistry and continue studies to a higher level in chemistry. Therefore, chemistry teachers are required to be able to design good and enjoyable learning, which is supported by selecting the right learning resources according to the characteristics of the material. Packing a learning experience designed by teachers is very influential in the experience of the students. This is due to the meaning built in students ' minds according to the learning context. Thummathong & Thathong (2016) declares chemistry literacy can be constructed by assessing the knowledge and understanding of the relationship between chemistry and the community, the application of analytical thinking, the application of reasoning, and the moral awareness and sense of responsibility [9].

This research aims to identify potential coastal and sea resources of Tomini Bay which can be used as a source of chemistry learning in senior high school based on the prevailing curriculum. This was done as a preliminary step in creating chemistry learning design in which it utilizes the potential of Tomini Bay resources. Resource-based learning in chemistry learning is expected to be a meaningful learning for students.

2. METHOD

This research was conducted in the coastal and sea areas of Tomini Bay, which are in direct contact with the provinces of Central Sulawesi, Gorontalo and North Sulawesi for two months. This is a qualitative research using primary data and secondary data. Data collection were conducted through the combination of field research and literature studies. Field research includes observation, interviews, and documentation in coastal communities and in the school environment to determine the use of Tomini Bay resources in everyday life and in the learning process by chemistry teachers. Literature studies from textbooks, research journals, and magazines were carried out to gather various information related to the potential of Tomini Bay resources that can be used in the chemistry learning process.

All data were analyzed using descriptive qualitative analysis to analyze the potential of the coastal and sea resources of Tomini Bay which are closely related to chemistry concepts in high school chemistry lessons. Data analysis was carried out interactively and continuously until saturated. Then perform data reduction to make it easier to understand the data from observations, interviews and documentation, data presentation to make it easier to understand the potential of Tomini Bay resources both as a whole and part by part and draw conclusions by paying attention to the results of observations, interviews and documentation regarding the description of the potential resources of Tomini Bay which are related closely with chemistry lessons.

The potential resources of Tomini Bay which can be used as a source of chemistry learning were validated by 5 chemistry teachers at the Tomini Bay coastal high school as expert judgment. Validation uses Likert scales, which is very good (5), good (4), quite good (3), not good (2), and not good (1). The validation results are converted into 4 value scales, namely very good, good, good enough, and not good. Quality is said to be valid if it meets the very good and good criteria.

3. RESULT AND DISCUSSION

3.1. Chemistry Learning in Senior High School Based on the Curriculum 2013

The curriculum 2013 is the curriculum that applies in Indonesia and has undergone a revision in 2016. This revision was made to adjust to the times and demands of learning in the current global era. The curriculum 2013 contains competency attainment of spiritual attitudes, social attitudes, knowledge, and skills that accommodate mastery of 21st century skills which are often referred to as 4C (creative, critical thinking, communication skills, and collaborative) and high order thinking skills through scientific work experience. By developing these competencies, it is hoped that they can form productive, creative, innovative and affective students.

Regulation of the Minister of Education and Culture Number 21 of 2016 concerning Basic and Secondary Education Content Standards regulates the scope of material and the level of competence of students that must be achieved for each subject referring to the 2013 curriculum. One of which is regulated is chemistry learning in senior high school. This regulation regulates the scope of chemistry material that students must study while studying in senior high school from grades X to XII and the level of competence that students are expected to achieve after studying chemistry.

Chemistry learning that is carried out refers to all the required competencies. Chemistry materials in senior high school are (1) the scientific method, the essence and role of chemistry in life, (2) atomic structure and the periodic

system, (3) chemical bonding and molecular structure, (4) electrolyte and nonelectrolyte solutions, (5) reduction and oxidation reactions, (6) nomenclature of inorganic and organic compounds, (7) stoichiometry, (7) thermochemistry, (8) reaction rates, (9) chemical equilibrium (10) acids and bases, (11) ionic equilibrium, (12) colligative properties of solutions, (13) electrochemistry, (14) the elements of noble gases, halogens, alkalis and alkaline earths, and period 3, (15) period 4 transition elements and their compounds, (16) alkanes derivatives, (17) benzene derivatives, (18) macromolecules (polymers, carbohydrates and proteins), (19) lipids, (20) hydrocarbons and petroleum, and (21) colloidal systems. Chemistry learning that is carried out refers to all the required competencies.

3.2. Potential Resources of Tomini Bay, Indonesia

Tomini Bay is the largest bay in Indonesia with an area of around 59.500 km2. This bay is known to the world as the heart of the coral triangle with its various peculiarities and potential resources because it is right on the equator. In the division of the area of biodiversity, this area is in the Wallace zone, which historically was a separate area from the continents of Asia and Australia. This bay is in direct contact with the provinces of Central Sulawesi, Gorontalo and North Sulawesi with 15 districts/cities and 23 estuaries of watersheds.

Districts and cities directly adjacent to the waters of Tomini Bay for (1) Central Sulawesi Province include Banggai District, Tojo Una-una District, Poso District, and Parigi Moutong District, (2) Gorontalo Province consists of Gorontalo City, Gorontalo District, Bone Bolango District, Boalemo District, and Pohuwato District, and (3) North Sulawesi Province covering Bitung City, Minahasa Utara District, Minahasa District, Minahasa Tenggara District, Bolaang Mongondow Timur District, and Bolaang Mongondow Selatan District.

In the middle of Tomini Bay, there are 56 series of islands known as the Togean Islands. The Togean Islands are included in the Tojo Una-una District area, which stretches up to 90 kilometers in length. Six of them are in the big category, namely Una-Una Island, Batulada Island, Togean Island, Talatakoh Island, Waleakodi Island, and Waleabahi Island. The rest are small beautiful islands. On these small islands, it is a tourist area that is always crowded with foreign tourists from Europe. Tomini Bay can be seen in Figure 1.

Figure 1 Tomini Bay, Indonesia

The Tomini Bay ecosystem as one of the twenty-six national marine areas has the potential for abundant coastal and sea resources for the development of nautical tourism areas and national food storage areas. The Tomini Bay area includes coral reef ecosystems, seagrass beds, and mangrove forests as well as tourist beaches and sea ports. UNESCO has also designated Tomini Bay as one of the world's treasures that should be protected. The reason is, this bay has a very promising marine potential including pelagic fish, reef fish, shrimp, sea cucumbers, seaweed and other sea biota. In addition, there are coastal plants such as nypa palm, coconut, clove, various types of flowers and others.

Several places for tourists on the coast and sea of Tomini Bay, namely the Togean Islands Sea National Park, Bogani Nani Wartabone National Park, Lembeh-Bitung Strait Sea Reserve, Tanjung Santigi Wildlife Reserve, Lombuyan Wildlife Reserve, Bakiriang Wildlife Reserve, Nantu-Boliyohatu Wildlife Reserve, Pangi Binangga Nature Reserve, Mount Tinombala Nature Reserve, Tanjung Api Nature Reserve, Panua Paguat Nature Reserve, Tanjung Panjang Randangan Nature Reserve, Mount Ambang Nature Reserve, Mount Dua Saudara Nature Reserve, Tangkoko Batuangus Nature Reserve, Olele Sea Park, Island Sea Park Bitila, Limba Island Sea Park, Buyat Sea Park, and Colo Volcano (an active volcano on Una-una Island).

Potential minerals, including gold, nickel, iron ore, limestone, quartz sand and others. In addition, there are petroleum and natural gas seven blocks that have auction status, namely Tomini Bay I, Tomini Bay II, Tomini Bay III, Tomini Bay IV, Tomini Bay V, Gorontalo Tomini Bay I, and Gorontalo Tomini II. The petroleum and natural gas in the exploitation stage, namely the Senoro Toili Block and the Matindok Block are supplied to the Donggi-Senoro LNG refinery and power generation.

The community in Tomini Bay is very heterogeneous, with several tribes living and interacting socio-economically in Tomini Bay, namely the Gorontalo, Bugis-Makassar, Bajo (sea tribe), Togean, Saluan, Minahasa, Bolangamongondow, Kabalutan and several other tribes. Each tribe has its own language, but generally uses Indonesian. People in Tomini Bay work as fishermen, farmers, traders and civil servants.

The results of the study obtained data on the potential of Tomini Bay coastal and sea resources in each regency and city. The potential resources of Tomini Bay are well managed by the community as a livelihood and to meet their daily needs. In addition, this resource potential is also managed by government agencies and private companies. The details can be seen in Table 1.

Table 1. Management of the Potential Resources of Tomini Bay in Several Areas

Potential of Tomini Bay resources	Region name	Management
Sea water and river water	Districts and cities throughout the coastal and sea regions of Tomini Bay	Community, private sector, and government
Pelagic fish, reef fish, shrimp, squid, and others	Districts and cities throughout the coastal and sea regions of Tomini Bay	Fishermen, home industry, private sector, and government
Seaweed cultivation	Parigi Moutong District, Boalemo District, and Minahasa Utara District	Community and government
Coral reefs, seagrass beds, and other sea biota	Districts and cities throughout the sea region of Tomini Bay	Fishermen and government
Mangrove forests, nypa palm, various types of flowers and other plants	Districts and cities throughout the coastal region of Tomini Bay	Community, home industry, and government
Coconut, clove, and others plantations	Districts and cities throughout the coastal region of Tomini Bay	Community
Togean Islands Sea National Park	Tojo Una-una District	Fishermen, private sector, and government
Bogani Nani Wartabone National Park	Bone Bolango District-Bolaang Mongondow Selatan District	Community and government
Lembeh-Bitung Strait Sea Reserve	Bitung City	Fishermen, private sector, and government
Four wildlife reserves (Tanjung Santigi, Lombuyan, Bakiriang, and Nantu-Boliyohatu)	Parigi Moutong District, Banggai District, Boalemo District-Gorontalo District	Community and government
Eight nature reserves (Pangi Binangga, Mount Tinombala, Tanjung Api, Panua Paguat, Tanjung Panjang Randangan, Mount Ambang, Mount Dua Saudara, and Tangkoko Batuangus)	Parigi Moutong District, Tojo Una-una District, Pohuwato District, Bolaang Mongondow Timur District, and Bitung City	Community and government
Four sea park (Olele, Bitila Island, Limba Island, and Buyat)	Bone Bolango District, Pohuwato District, Boalemo District, and Minahasa District	Fishermen, private sector, and government

Potential of Tomini Bay resources	Region name	Management
Colo Volcano on Una-una Island	Tojo Una-una District	Community and government
Life of the Bajo Tribe (sea tribe)	Districts throughout the coastal region of Tomini Bay and Togean Islands	Bajo community
Gold Mining	Parigi Moutong District, Bone Bolango District, Bitung City, Minahasa Utara District, Minahasa Tenggara District, Bolaang Mongondow Timur District, and Bolaang Mongondow Selatan District	Local community, private sector, and government
Nickel Mining	Banggai District and Tojo Una-una District	Private sector and government
Iron Ore Mining	Tojo Una-una District, Banggai District, Bone Bolango District, and Minahasa Utara District	Private sector and government
Limestone	Poso District, Tojo Una-una District, Banggai District, Gorontalo City, Gorontalo District, and Minahasa Tenggara District	Community and government
Quartz sand	Poso District, Banggai District, Parigi Moutong District, Gorontalo District, Minahasa Utara District, and Minahasa Tenggara District	Home industry, private sector, and government
Petroleum and natural gas	Donggi-Senoro LNG refinery in Banggai District and seven blocks Tomini Bay in Parigi Moutong District and Gorontalo Province	Private sector and government

The potential of coastal and sea resources in Tomini Bay should open up opportunities for the world of education to apply them in teaching and learning activities so as to protect local resources and prevent damage. A partial portrait of these resource potentials can be seen in Figure 2.

2(a)

2(b)

2(c)

2(d)

2(e)

2(f)

Figure 2 (a) The condition of Tomini Bay; (b) mangrove forests; (c) seaweed; (d) salted fish; (e) clove oil distillation; and (f) nickel

3.3. Potential Resources of Tomini Bay as a Source of Chemistry Learning in Senior High School

The results of field studies in the community and in the school environment to determine the use of Tomini Bay resources in everyday life, which are closely related to the learning process, were found not to be carried out by chemistry teachers optimally.

The potential resources of Tomini Bay as a source of chemistry learning in senior high schools were reviewed by five chemistry teachers as expert judgment. From the results of the expert judgment validation, there are also suggestions in the form of additional potential resources of Tomini Bay, namely brackish water, traditional salt ponds, spirulina, cocoa, fish cultivation, *Ipomoea pes-caprae*, lime, and guava. These suggestions are then used to improve the prototype of the potential resource of Tomini Bay as a learning resource. The results of the validation are shown in Table 2 which meet the valid quality.

Table 2. Management of the Potential Resources of Tomini Bay in Several Areas

Aspects of Measurement	Average Score	Maximum Score	Category
Completeness of the potential resources of Tomini Bay	4.80	5.00	Very good
Completeness of chemistry materials on the Curriculum 2013	5.00	5.00	Very good
Linkage of potential resources of Tomini Bay and chemistry materials	4.80	5.00	Very good
The suitability of chemistry learning activities with the demands of the Curriculum 2013	4.60	5.00	Very good
The suitability of chemistry learning activities with the characteristics of senior high school students on the coast of Tomini Bay	4.60	5.00	Very good

In general, the potential of Tomini Bay coastal and sea resources can be grouped, consisting of water, fisheries and marine cultivation, coral reefs and sea biota, mangrove forests and coastal plants, plantations, conservation and recreation areas, and mining. This is done to make it easier to analyze each potential resource that can be associated with one or more chemical materials as shown in Table 3.

Table 3. Potential Resources of Tomini Bay as a Source of Chemistry Learning

Competence	Potential of Tomini Bay Resources	Chemistry Materials	Subject/Activity
Applying the basic laws of chemistry, energetics, kinetics and equilibrium to explain related phenomena such as reaction spontaneity and the factors that influence the course of a reaction. Designing and conducting chemistry experiments that include problem formulation, proposing hypotheses, determining variables, choosing instruments, collecting, processing and analyzing data, drawing conclusions, and communicating the results of experiments orally and in writing. Analyze and solve problems related	*Water* Sea water, brackish water and river water	The scientific method, the essence and role of chemistry in life	Observing products in everyday life, for example table salt from seawater, distilled water and bottled water as well as the formation of deltas in estuaries and water purification containing chemicals.
		Electrolyte and nonelectrolyte solutions	Design and conduct experiments to investigate electrolyte properties of some solutions present in the environment and report experiments.
		Colligative properties of solutions	Describes the application of the colligative properties of solutions in the preparation of traditional salt and distilled water.
		Colloidal systems	Carry out experiments to observe and identify colloids from their physical appearance and some of their general properties.
	Fisheries and marine cultivation Pelagic fish, reef fish, shrimp, squid, and others Traditional salt ponds, fish cultivation, pearl cultivation, and seaweed cultivation	The scientific method, the essence and role of chemistry in life	Observing processed fish products such as smoked fish, salted fish, salted squid, fish oil, shrimp chips, and shredded fish that contain fat and protein that the body needs. Design and conduct scientific experiments, for example determining the variables that influence the crystallization of traditional salt from seawater.
		Colligative properties of solutions	Applying the colligative properties of solutions to the manufacture of salted fish and salted squid.
		Lipids	Discuss and present the manufacture of fish oil products.
		Colloidal systems	Observing various types of colloids such as pearl jewelry and seaweed jelly. Manufacture of food or processed seaweed products involving the colloid principle.
	Coral reefs and sea biota	The scientific method, the essence and role of chemistry in life	Observing coral containing $CaCO_3$, seagrass seeds (*Enhalus acoroides*) which contain carbohydrate and protein, sea cucumber which contain protein and fat, and spirulina as a

Competence	Potential of Tomini Bay Resources	Chemistry Materials	Subject/Activity
to molecular properties, chemical reactions, chemical equilibrium, chemical kinetics, and energetics, and apply this knowledge to various fields of science and technology. Applying basic principles of chemistry, structure and energetics to analyze physical and chemical phenomenon with regard to the physical properties of solutions, the interaction of electrical energy with chemical changes, and the physicochemical properties of elements and compounds.	Coral reefs, seagrass beds, sea cucumbers, spirulina, and others		drug that contains the most complete vitamin B complex: B1, B2, B3, B6, and B12.
		Reaction rates	Design and conduct experiments on the factors that affect the reaction rates using coral and report the results.
		Chemical equilibrium	Discusses dynamic equilibrium reactions in the formation and decomposition of corals
		Macromolecules (polymers, carbohydrates, and proteins)	Discusses the properties and uses of carbohydrates from seagrass seeds (*Enhalus acoroides*). Discusses the properties and uses of protein from sea cucumbers.
	Mangrove forests and coastal plants Mangroves, nypa palm, *Ipomoea pes-caprae*, lime, guava, various types of flowers, and other plants	The scientific method, the essence and role of chemistry in life	Observing mangrove products, such as chips from *Avicennia alba* fruit, cake flour from *Bruguiera gymnorrhiza* fruit, syrup from *Sonneratia alba* fruit, cancer medicinal tea from *Acanthus ilicfoilous* leaves, and liquid soap from *Sonneratia alba* fruit which contains chemicals. Observing the nypa palm fruit that contains carbohydrates.
		Chemical bonding and molecular structure	Creating and explaining molecular shape models from natural, round shapes such as *Ipomoea pes-caprae* flowers, lime, guava, and others.
		Reduction and oxidation reactions	Observing the oxidation reaction through color changes in mangrove fruit slices.
		Reaction rates	Observing some of the reactions that occur around us, for example mangrove branches that are burned dry, discoloration of mangrove fruit pieces, and making nypa palm vinegar.
		Acids and bases	Test acid and alkaline solutions with natural indicators of plant and flower extracts.
		Macromolecules (polymers, carbohydrates, and proteins)	Discusses and presents the manufacture of a product from macromolecules, namely acetic acid and alcohol from carbohydrates in the process of making vinegar from nypa palm.

Competence	Potential of Tomini Bay Resources	Chemistry Materials	Subject/Activity
Describes the application of basic chemical principles to natural phenomena and to products.		Hydrocarbons and petroleum	Discusses the types of C atoms based on the number of C atoms attached to the chain of carbon atoms (primary, secondary, tertiary, and quaternary C atoms). Find various hydrocarbon molecular structures from the same molecular formula using round natural materials such as *Ipomoea pes-caprae* flowers, lime, guava, and others.
	Plantations Coconut, cocoa, clove, and others	The scientific method, the essence and role of chemistry in life	Observing coconut, cocoa and clove products that contain fat, oil and protein.
		Electrolyte and nonelectrolyte solutions	Discusses the function of electrolyte solutions and how to overcome electrolyte deficiencies in the body by drinking coconut water.
		Reaction rates	Inhibits chemical reactions to spoilage of fish using coconut shell liquid smoke.
		Lipids	Discusses and presents the manufacture of cooking oil and VCO from beach coconut and the distillation of essential oil from clove stalks and leaves.
		Hydrocarbons and petroleum	Discuss and identify hydrocarbon compounds in organic materials in the process of making liquid smoke and charcoal from coconut shells.
		Colloidal systems	Conducted experiments to observe and identify colloids from their physical appearance (appearance) and some of their characteristics in general using coconut milk. Making *Moringa oleifera* vegetables typical of the kaili tribe in Central Sulawesi and coconut milk which is colloid.
	Conservation and recreation areas Togean Islands Sea National Park, Bogani	The scientific method, the essence and role of chemistry in life	Discusses and presents the role of chemistry in optimizing the utilization of potential resources owned by the region while maintaining the environment so that it is not damaged by the use of fish bombs, the use of pesticides to poison fish, illegal logging of mangrove forests, and littering and littering. Discusses and presents the role of chemistry in the mastery of other basic sciences, such as biology, physics, geology, and applied sciences such as mining, health, agriculture,

Competence	Potential of Tomini Bay Resources	Chemistry Materials	Subject/Activity
	Nani Wartabone National Park, Lembeh-Bitung Strait Sea Reserve, Colo Volcano, the life of the Bajo Tribe, and other.		fisheries and technology to optimize the use of potential resources owned by regions by preserving their sustainability.
	Mining Gold, nickel, iron ore, limestone, quartz sand, petroleum and natural gas, and other	Chemical bonding and molecular structure	Discuss the Lewis theory of bonding and write down the Lewis structure of $CaCO_3$ molecules contained in limestone and SiO_2 and Al_2O_3 molecules contained in quartz sand.
		Period 4 transition elements and their compounds	Identify products that contain the period 4 transition elements and other transition elements including Au, Ni, and Fe.
		Hydrocarbons and petroleum	Observing hydrocarbon compounds in petroleum products in everyday life, such as road asphalt, candles, oil, diesel, kerosene, plastics, gasoline, and LPG cylinders and flames on gas stoves. Analyzing the multilevel distillation process to produce petroleum into its fractions.

Table 3 shows that there are 13 out of 21 chemical materials that can be taught using the potential resources of Tomini Bay, namely (1) the scientific method, the nature and role of chemistry in life, (2) chemical bonding and molecular structure, (3) electrolyte and nonelectrolyte solutions, (4) reduction and oxidation reactions, (5) reaction rates, (6) chemical equilibrium, (7) acids and bases, (8) colligative properties of solutions, (9) period 4 transition elements and their compounds, (10) macromolecules (polymers, carbohydrates, and proteins), (11) lipids, (12) hydrocarbons and petroleum, and (13) colloidal systems. In addition, it also shows chemistry learning activities that are in accordance with the potential resources of Tomini Bay. The determination of the activity itself is adjusted to the chemistry characteristics and the demands of the 2013 curriculum which demands a learning process including observing, questioning, gathering information, associating, and communicating.

Utilizing the potential resources of Tomini Bay as a learning resource for chemistry can maximize the learning process. Students can observe a lot of interrelated material, by utilizing one of the potential local resources as a learning resource. Through contextualization of chemistry learning that is in accordance with environmental conditions and student characteristics will show a more meaningful learning experience so that the learning process becomes more effective [10]. Students can feel that chemistry learning is very closely related to life, not only in the form of theory and abstract nature but can apply them in managing and maintaining regional potential well. This is in accordance with what was stated by Yavuz-Topaloglu & Balkan-Kiyici

(2015) that the contribution of the environment greatly affects science learning in improving students' conceptual understanding [11]. Advances in science produce many ways to benefit from environmental systems [12]. The integration of higher-order thinking skills in the learning process is needed among students [13]. This can add to a higher understanding in solving various multidimensional problems related to economy, social, culture, environment, and technology.

4. CONCLUSION

The results showed that the potential of Tomini Bay coastal and sea resources which intersect directly with the provinces of Central Sulawesi, Gorontalo, and North Sulawesi include water, fisheries and marine cultivation, coral reefs and sea biota, mangrove forests, coastal plants, plantations, conservation and recreation areas, and mining. The potential of coastal and sea resources can be used as a resource in learning chemistry for high school curriculum 2013 on the scientific method, the essence and role of chemistry in life, chemical bonding and molecular structure, electrolyte and nonelectrolyte solutions, reduction and oxidation reactions, reaction rates, chemical equilibrium, acids and bases, colligative properties of solutions, period 4 transition elements and their compounds, macromolecules (polymers, carbohydrates, and proteins), lipids, hydrocarbons and petroleum, and colloidal systems. From the results of the study, it can be concluded that Tomini Bay resources can be used as a source of chemistry learning which is a promising choice for studying chemistry.

REFERENCES

[1] Apridar, *Pembangunan Maritim; Peluang dan Tantangan Ironi Negeri Sejuta Nyiur Hijau di Pantai: Pemberdayaan Nelayan & Pembangunan Maritim di Indonesia*. Yogyakarta: Graha Ilmu, 2015, pp 1–20.

[2] R. Dahuri, J. Rais, S. P. Giting, and M. J. Sitepu, *Pengelolaan Sumber Daya Wilayah Pesisir dan Lautan Secara Terpadu*. Jakarta: Balai Pustaka, 2013, pp. 1

[3] BPS, *Kajian Sosial dan Ekonomi Desa Maritim*. Jakarta: Badan Pusat Statistik Indonesia, 2015.

[4] R. Damanik and R. Djamaludin, *Atlas mangrove Teluk Tomini*. Gorontalo: Program SUSCLAM, 2012.

[5] G. Sontay, M. Gokdere, and E. Usta, "A comparative investigation of sub-components of the environmental literacy at the secondary school level," *J. of Turkish Sci. Edu.*, vol. 12, pp. 19-28, 2015.

[6] Parmin, Sajidan, Ashadi, Sutikno, and Y. Maretta, "Preparing prospective teachers in integrating science and local wisdom through practicing open inquiry," *J. of Turkish Sci. Edu.*, vol. 13, pp. 3-14, 2016.

[7] G. Sirhan, "Learning difficulties in chemistry: an overview," *J. of Turkish Sci. Edu*., vol. 4, pp. 2-20, 2007.

[8] S. Fang, C. Hart, and D. Clarke, "Identifying the critical components for a conceptual understanding of the mole in secondary science classrooms," *J. Research in Sci. Teaching*, vol. 53, pp. 181-214, 2016.

[9] R. Thummathong and K. Thathong, "Construction of a chemical literacy test for engineering students," *J. of Turkish Sci. Edu.*, vol. 13, pp. 185-198, 2016.

[10] A. Mallya, F. M. Mensah, I. R. Contento, P. A. Koch, and A. C. Barton, "Extending science beyond the classroom door: Learning from students' experiences with the choice, control and change (C3) curriculum," *J. of Research in Sci. Teaching*, vol. 49, pp. 244-269, 2012.

[11] M. Yavuz-Topaloglu and F. Balkan-Kiyici, "The opinions of science and technology teachers regarding the usage of out-of-school learning environments in science teaching," *J. of Turkis Sci. Edu*., vol. 12, pp. 31-50, 2015.

[12] J. Ruppert and R. G. Duncan, "Defining and characterizing ecosystem services for education: A Delphi study," *J. Res. Sci. Teach*., vol. 54, pp. 672-689, 2017.

[13] G. V. Madhuri, V. S. S. N. Kantamreddi, and L. N. S. Prakash-Goteti, "Promoting higher order thinking skills using inquiry-based learning," *Europ. J. Eng. Edu*., vol. 37, pp. 117-123, 2012.