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Bioeconomy Through the Perspective of Science Teachers

***Semih Esendemir, **Burcu Anılan**

Abstract. The concept of bioeconomy, which was put forward to solve today's most important global problems such as climate crisis, rapid population growth, environmental pollution and increasing energy need, has gained great importance in solving problems. This study aims to determine the opinions of science teachers about bioeconomy, who can play an active role in introducing and promoting the concept of bioeconomy, which is put forward for a sustainable future, to future generations. Due to the purpose of the study, which involves a detailed description of the current situation, a descriptive case study pattern was used. The participants of the research consist of eight science teachers working in institutions affiliated to the Ministry of National Education. Since it was aimed to reveal the views of science teachers about bioeconomy in depth, the data were collected by semi-structured interview. Main themes were determined in accordance with the research questions and the interviews were analyzed descriptively. According to the data obtained, it demonstrates that most of the science teachers who make up the study group do not recognize the concept of bioeconomy, do not include it in their lessons in parallel with the fact that it is not included in the science curriculum, and cannot relate this concept to real life problems. It is considered that this research will contribute to bioeconomy education and research.

Keywords. Bioeconomy, sustainable environment, science education, science teacher, qualitative research.

*** (Responsible Author)** Science Teacher, Emine Emir Şahbaz Science and Art Center, Eskişehir, Türkiye

e-mail: semicch26@gmail.com

****** Assoc. Prof. Dr., Eskişehir Osmangazi University Faculty of Education, Eskişehir, Türkiye

e-mail: anilan.burcu@gmail.com

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Climate crisis, rapid population growth, environmental pollution and increasing energy need are considered as the most important global problems of today. Climate change is a global problem that has reached the level of crisis today and has trans boundary effects. Rising sea levels as a result of increasing global average temperatures, increases in the number, frequency and severity of extreme weather events and disasters such as floods, droughts and storms, and the prevalence of public health problems; are consequences of climate change in cities (Tuğaç, 2022). In terms of sustainable development, these global problems also threaten the sustainability of resources in the world (Kitapçı, 2017). The Lund Declaration (2015) states that there is a need for sustainable solutions for global problems such as global warming, increasing energy demand, decreasing water and food resources, public health, epidemics and security. Einstein said; "We cannot solve our problems with the same thinking we used when we created them." As Einstein's statement, we need to change our perspective towards solving the problems we encounter and to produce alternative solutions (Zilberman, Kim, Kirschner, Kaplan, & Reeves, 2013). Even though there are many problems, the concept of bioeconomy was suggested to solve some of the problems and was considered as an important part of the solution (Bugge, Hansen, & Klitkou, 2016). Bioeconomy, as Europe's response to the main environmental challenges that the world faces, defines reducing reliance on natural resources, transforming production, promoting the sustainable production of renewable resources from land, fisheries, aquaculture, and encouraging their conversion into food, feed, fiber, bio-based products and bio-energy (European Union, 2020). Bioeconomy encompasses a paradigm shift from an economy based on fossil fuels to an economy based on renewable natural resources such as water, solar, wind and biomass (Hakovirta & Lucia, 2019). Through bioeconomy, products obtained from non-renewable resources such as fossil fuels will be exchanged with products produced from renewable resources such as biofuels (Zilberman, Kim, Kirschner, Kaplan, & Reeves, 2013). In this context, the transition from fossil-based products to biological-based products and energy is very important in terms of solving global problems (Bugge, Hansen, & Klitkou, 2016).

The concept of bioeconomy has a very important place in the economic growth of countries and in creating employment. A sustainable future depends on prioritizing education, policies and strategies to develop the concept of bioeconomy, and establishing successful connection of education systems with social innovation and bioeconomy. As emphasized in the Sustainable Development Goals, which is a call for universal action that includes the goals aimed to be achieved by the member states of the United Nations for the solution of global problems by the end of 2030,

it is necessary to raise awareness in the society in the transition to bioeconomy practices and to involve the society as a whole in the learning process (Urmetzer, Lask, Vargas, Carpintero, & Pyka, 2020).

Developing a more flexible educational framework that can facilitate the integration of bioeconomy with daily life is probably one of the most important challenges that scientists, educators and practitioners will face in the near future (Sacchi, Lotti, & Branduardi, 2021). In order to create a perception of bioeconomy that increases sustainable use, education programs should keep up with international teaching and learning exchanges and allow the creation and sharing of open learning platforms, curricula and educational content (El-Chichakli, von Braun, Lang, Barben, & Philp, 2016). BLOOM, a coordination and support project funded by the European Union's Horizon 2020 framework, emerged to support teachers in producing new teaching resources on bioeconomy, testing these resources in their classrooms and providing feedback on their applications. It also supports teachers' collaboration with other teachers and schools to disseminate their bioeconomy-related work, resources and opportunities in their region (Cossu, 2019). Along with this project introduced by the European Union, European educational institutions acknowledged that individuals with qualified workforce are needed for development in the field of bioeconomy and stated that young scientists should be trained on this subject (Papadopoulou, et al., 2018). The first goal in bioeconomy education is to provide training to introduce the concept of bioeconomy to students. Afterwards, students are expected to resume their studies in a way that addresses needs in science, industry and society by making them contact with experienced professionals. Research, innovation and cooperation have a very important place in achieving these goals (Wohlgemuth, Twardowski, &Aguilar, 2021).

In the bioeconomy workshop held in 2013, decisions were made to determine and monitor bioeconomy-related strategies, then to cooperate with bioeconomy stakeholders, to conduct Ar-Ge activities, to develop advanced technological products and to create products with economic value from biological-based sources (Arısoy & Avcı, 2020). In our country, a structure is being formed that focuses on biotechnological studies in the relationship between human, agriculture and environment and attaches importance to R&D activities that support the production of sustainable technologies (Bayramoğlu, Açan, & Tekin, 2018). It can be said that the meat, oil and fruit juice industries and domestic oil wastes generated at homes are biologically based resources and these resources create a great energy potential for our country (İşçi, 2015). When the studies carried out in our country are examined; Avcı (2019) examined the relationship between bioeconomy and

agriculture on the potential and opportunities of medicinal and aromatic plants in Konya, Durmuş and Koçer (2017) investigated the potential for biodiesel production from oil seeds grown in Türkiye. Aybek et al. (2015) and Korkmaz et al. (2012) developed studies to determine the biogas energy potential of usable organic wastes in Türkiye. In the field of education, Özkara and Keklik (2021) talked about the creative drama activity they designed on the teaching of the concept of bioeconomy. When the studies are examined, it is seen that the studies in the field of agriculture, energy and biotechnology are more than the studies in the field of education and the studies in the field of education are limited. It is thought that studies in the field of education are important in order to recognize the concept of bioeconomy, to accelerate the studies in the fields of agriculture, energy and biotechnology, and to ensure the dissemination of bioeconomy applications. Among the decisions taken at the bioeconomy workshop held in 2013, it is emphasized that education, publication and publication activities should be given importance in order to develop the human resources that will be needed in the field of bioeconomy (Arısoy & Avcı, 2020). For these reasons, this study aims to determine the opinions of science teachers about bioeconomy, who can play an active role in introducing the concept of bioeconomy to future generations, obtaining qualified workforce in this field and encouraging the development of biotechnological products. For this purpose, answers were sought for the following sub-problems.

• What is the knowledge level of science teachers about the concept of bioeconomy?

• What is the relationship between science teachers and bioeconomy and daily life?

• What are the views of science teachers about the relationship between the secondary school science curriculum and the concept of bioeconomy?

It is thought that the study will reveal the views of science teachers in the field of bioeconomy in detail and will guide teachers and researchers in terms of bioeconomy education and research.

Method

Research Design

In this study, qualitative research was used as a method and a descriptive case study was used as a design (Yin, 1984). A case study is a type of qualitative research in which any situation is investigated in depth. Case studies focus on how factors such as the environment, individual, process related to the situation affect the situation or how they can be affected by the relevant situation (Yıldırım & Şimşek, 2008). The descriptive case study focuses on an intervention and the

purpose of describing the phenomenon and the real-life context in which it emerges (Merriam, 1998; Yin, 1984). The aim of this study is to investigate the views of science teachers about bioeconomy in depth. For this reason, the case study design used in the qualitative research method was preferred in accordance with the purpose of the study.

Study group

The study group consists of 8 science teachers working in institutions and organizations affiliated with the Ministry of National Education, who were contacted with easily accessible sampling method. The reason for using the easily accessible sampling method; It is the method that enables the sample to be selected from among the people who are close to the researcher. Teachers participated in the research on a voluntary basis. Demographic characteristics of the teachers participating in the research are given in Table 1.

Table1.

Demographic Characteristics of the Teachers

Teacher	Gender	Age	Seniority Year	City	Institution Type	Sustainable Environmental Education Status
T1	Female	36	13	İzmir	State	-
T2	Female	29	8	Aydın	Private	+
T3	Female	28	7	İstanbul	State	+
T4	Female	36	13	İstanbul	State	+
T5	Female	35	13	Ankara	State	-
T6	Male	29	8	Ankara	Private	+
T7	Female	38	14	Bursa	State	-
T8	Male	34	10	Hatay	Private	+

The study group consists of 8 teachers, 6 female and 2 male. Teachers' ages range from 28 to 36, while their seniority is between 8 and 14 years. The teachers in the study group work in public

and private schools affiliated to MoNE in the provinces of Ankara, Aydın, Bursa, Hatay, Istanbul and Izmir. 5 of the teachers in the study group received sustainable environmental education and 3 did not receive sustainable environmental education.

Data Collection and Analysis

One of the data collection tools used in qualitative research is the interview. In this study, since it was aimed to reveal the views of science teachers about bioeconomy in depth, the data were collected by semi-structured interview. The semi-structured interview form was prepared by the researchers and the opinions of a Turkish teacher and two field experts were taken while the questions were being prepared. After an interview with a teacher other than the participant group, arrangements were made regarding the clarity of the questions and the form was finalized. The interviews, which lasted an average of 20 minutes, were conducted online and recorded. The interview form consists of two parts and 14 questions. In the first part of the interview form, there are questions about the demographic characteristics of the participants. In the second part, which is prepared to get the opinions of teachers about the concept of bioeconomy, there are questions that reveal the relationship of the concept of bioeconomy with daily life and Science lessons.

The main themes identified in accordance with research questions and interviews were analyzed descriptively. Descriptive analysis is the organization and interpretation of the data obtained as a result of the interview. Data are classified, summarized and interpreted according to themes. A cause-effect relationship is established between the findings and, if necessary, comparisons are made between the cases (Yıldırım & Şimşek, 2008). Qualitative data to be collected by semi-structured interview technique were analyzed separately by two researchers in order to ensure the reliability of the research. In order to increase the validity and reliability of the research, participant confirmation was provided and direct quotations were made from the participant's views. Reliability of the study since this rate calculated using the formula developed by Miles and Huberman (1994) was found to be 91%, it can be said that the study is quite reliable.

Results

This study aims to determine the views of science teachers about bioeconomy. The opinions of 8 science teachers were obtained through interviews conducted in online environments. The data analyzed descriptively after the interviews were gathered under three main themes and discussed by quoting the teacher's statements. In this chapter; as it can be seen in Figure 1 the views of science

teachers on bioeconomy are presented under the themes of “The concept of bioeconomy”, “Bioeconomy and daily life”, and “Bioeconomy in Science class”.

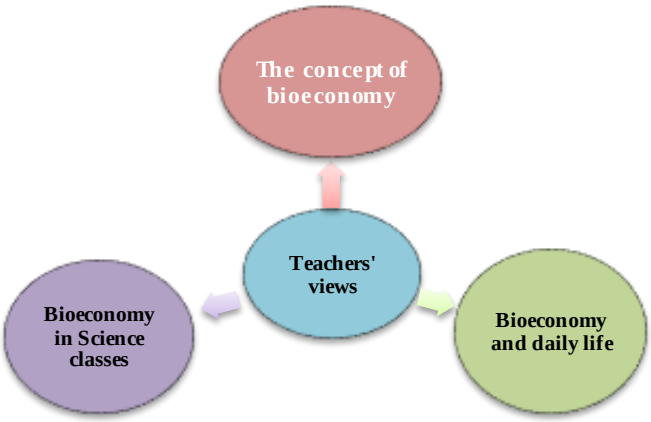

Figure 1. The Themes Obtained from the Views of Science Teachers.

The Concept of Bioeconomy

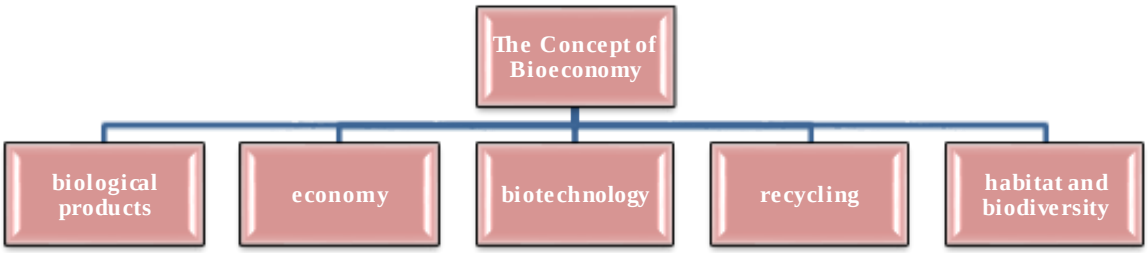

Figure 2. The Codes Obtained for the Theme of "Bioeconomy Concept" of Science Teachers.

Under the theme of "The Concept of Bioeconomy", it can be observed that teachers associate the concept of bioeconomy with biological products, economy, biotechnology, recycling, habitat and biodiversity. While T1 from public school teachers associated the concept of bioeconomy with economy in general in the expressions "The effect of biological products on the economy" and T4 "Economic income from recyclable sources", T2 from the teachers working in private school "Bio" means that a living thing exists, integrating technology in an environment and obtaining biotechnological products", T6 “The problems experienced by the concept of economic niche and habitat in this concept, where economic developments and environmental factors are very closely intertwined and affect each other" and T8 "The contribution of biodiversity to the economy in our

lives", in these statements teachers discussed bioeconomy thoroughly in the context of biodiversity, biotechnology and the environment.

The teachers stated the concepts they associated with the concept of bioeconomy. Then, they defined the concept of bioeconomy. It was observed that the teachers, except for the teacher coded T6, heard the concept of bioeconomy for the first time, were not familiar with the concept of bioeconomy, and tried to define the concept of bioeconomy based on the words bio and economy, and they had difficulties in doing so. While T1 defined bioeconomy as" I can describe it as the contribution of herbal products such as hemp and some animal products to the country's economy." T4 said, "Bioeconomy is a concept I have not heard before so I can only interpret it as a word and define as practices that will ensure the continuity of human and nature together with recycling", T5" There is a biological richness and diversity, I define it as the economic use of this diversity.", T6" There is a product produced with biotechnology, and this product has actually been revealed by biotechnological studies and provides a very serious economic advantage.", and T7 defined it as "I don't know the concept of bioeconomy actually, but it is a science that tries to obtain efficient and high quality products from all living things in the world." . As it can be observed that T4 emphasized more on sustainability in her statement, T1; T5; T6; T7 defined it focusing more on economy.

When the teachers' definitions of the concept of bioeconomy are examined, it can be seen that the lack of resources, industrialization, population growth, economic developments, global climate crisis and environmental pollution come to the forefront. While T2, one of the teachers with less seniority drew attention to the ease of access to raw materials as the reason for the emergence of bioeconomy in her following statement: "Using living things as raw material is an advantage for us. Because it is easy to access and preferring what you can reach will benefit you more.", teachers with more seniority explained the need for raw materials and bioeconomy in detail within the framework of global problems in their following statements: T1" There has to be an economic input and it can mean better evaluating biological products, getting to know them better and discovering which product works for what.", T4" It is the step taken by countries to take the environment into account in economic gains due to the increasing environmental pollution and the global climate crisis.", T5" I think it emerged from the idea that future generations will experience resource shortages and that there will be no sustainable environment and biodiversity as a result of resource shortages and their senseless use." and T7" Such a need may have arisen in order to reduce the increasing urban populations due to industrialization and the damage caused by these human masses

to the world.” This study aims to determine the views of science teachers about bioeconomy. The opinions of 8 science teachers were obtained through interviews conducted in online environments. The data analyzed descriptively after the interviews were gathered under three main themes and discussed by quoting the teacher's statements. In this chapter; as it can be seen in Figure 1 the views of science teachers on bioeconomy are presented under the themes of “The concept of bioeconomy”, “Bioeconomy and daily life”, and “Bioeconomy in Science class”.

Bioeconomy and Daily Life

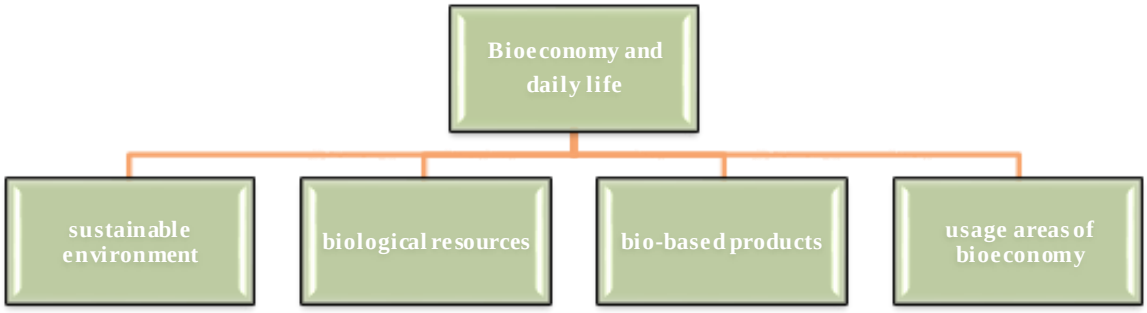

Figure 3. The Codes Obtained for the Theme of "Bioeconomy and Daily Life" of Science Teachers.

It is obvious that even though the teachers establish a relationship between the concept of bioeconomy and sustainable environment under the theme of “Bioeconomy and daily life”, they are insufficient in explaining this relationship. The teachers expressed that there is a relationship between bioeconomy and sustainable environment in their following statements: T1” When the “bio” part is included, it is already intertwined with the environment. If it is necessary to obtain biological products, most likely the environment must be in good condition, so that these products can be produced easily, because if there are problems such as environmental pollution or other kinds of problems, we may not be able to obtain biological products. That's why these two concepts are actually intertwined.”, T3” If we get bioeconomic products, we'll really be in a very different position in terms of sustainability, and replacing plastics would be really amazing, even if we don't say glass anymore. It definitely impacts sustainability in a great way.”, T5” I think that the concept of sustainable environment depends on bioeconomy, so I think it is one of the pillars of bioeconomy for a sustainable environment.” and T7” If we consider the sustainable environment as an important part of sustainable development, transferring resources to other generations and not using biological resources unless necessary, of course it has a lot to do with bioeconomy.”

The teachers, who stated that the concept of sustainable environment and bioeconomy are related to each other, also stated that there is a relationship between bioeconomy and the concepts

of "biological resources" and "biological-based products". It is seen that teachers explain the relationship between biologically based resources and products in their following statements: T1" Famous brands are now turning to sustainable fabrics. When you buy clothes, they have sustainable tags on them.." and T4" Products obtained from nature, the environment, that is, soil, seas, animal and vegetable wastes can be biologically based." Other teachers explain the relationship between biologically based resources and products by giving examples from daily life. In their following statements: T2" If I consider the example of fruit yoghurt as a bio-based product, the use of fruit, which is an organic substance, as a sweetener with more microorganisms with biotechnological methods can be an example of bioeconomy.", T3" Other than recycling products, for example, fruit, vegetables, egg wastes and olive pits remained in my garbage. Actually, these are all biological wastes and I came across something recently and I really liked it. They made a toothbrush from olive seeds. It is an amazing and excellent idea. In addition, in a training I attended, I learned that Arçelik contributes to sustainability by recycling the eggshells by using the eggshells in their factories, even though I do not remember what they are used for. These two examples can be good examples of bio-based products and bioeconomy." and T5" We can give examples of materials that are constantly produced and often made of rubber, many materials made from coffee beans, and I think that all of them are related to biodiversity."

The teachers, who explained the relationship of bioeconomy with biological-based resources and products by giving examples from daily life, stated the areas where bioeconomy is used or can be used and the sectors it covers as agriculture, animal husbandry, textile, food, health, education and energy. While T7 who didn't receive any training on bioeconomy and Sustainable environmental education explained the areas where bioeconomy is used with traditional application examples in her statement: "The skins obtained from animals can be used, for example, in the manufacture of clothes and shoes in the field of textiles, in agriculture by turning the vegetable and fruit wastes from the markets into fertilizer or in the field of livestock by turning them into animal feed." In their following statements T3, T6 and T8 explained the areas where bioeconomy is used with current application examples. T3," I can give examples of the health sector with the toothbrush produced from olive pits, and the agriculture sector with compost. In fact, it can be used in many areas, the simplest, we can even use it in the education sector with compost production or biological waste accumulation in our schools.", T6" It is definitely used in the field of energy and especially in the field of health with vaccine studies in the field of biotechnology during the pandemic period."

and T8" It is already used in agriculture as a sector. For example, we started to obtain worm manure in our school, it is very important for plants."

Bioeconomy in Science Classes

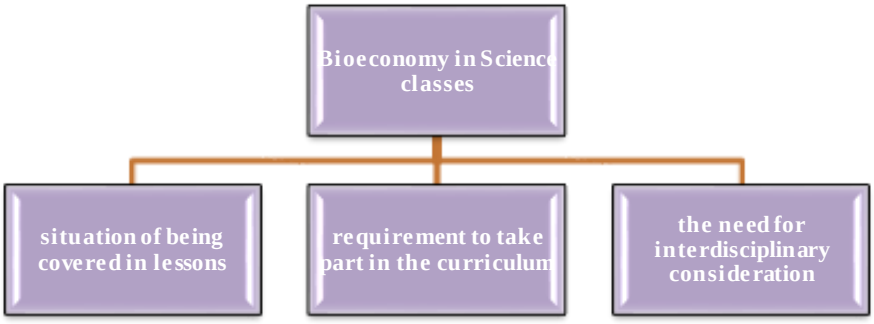

Figure 4. The Codes Obtained for the Theme of "Bioeconomy in Science Lessons" of Science Teachers.

Under the theme of "Bioeconomy in Science classes" the teachers stated that they did not include the concept of bioeconomy, which is not included in the Science Curriculum, in their courses, but they tried to associate this concept with the concepts of recycling, environmental pollution, biodiversity, biotechnology, and sustainable development in their courses The teachers explained what kind of applications they conducted in their courses about the concept of bioeconomy in their following statements, T3" Since I heard the concept of bioeconomy for the first time, I explain what recycling is within the scope of the domestic waste and recycling chapter in the 7th grade curriculum, rather than bioeconomic activities, and I share the examples made in the health and agriculture sector.", T5" I try to do activities to develop design skills within the unit of people-environment and biodiversity topics in the 5th grade curriculum, renewable and non-renewable energy resources in the 6th grade curriculum and recycling for a sustainable environment in the 8th grade curriculum. Although we do not touch on the concept of bioeconomy here, we try to instill environmental awareness at every class level.", T6" Apart from club work related to science, I teach classes at all levels. To give an example regarding bioeconomy, I did a study on both recycling and upcycling throughout the school. We grew compost and vermicompost from the wastes generated in the cafeteria in our own school garden and ensured that these foods were reused in the cafeteria. In fact, the concept of sustainability was critical here." T7" Although I do not touch on the concept of bioeconomy, I give examples of sustainable development in the 8th grade curriculum." and T8" I did not include the concept of bioeconomy, but I included the biological situation, I included the economic situation. Regarding the diversity of matter, I

mentioned the diversity of living things in product diversity. In fact, we do not know the financial value of biological-based products later on. We cannot convey or defend something we do not know."

Teachers emphasized that the concept of bioeconomy, which is not included in the Science Curriculum, should be included in science courses. While Ö4 stated the importance of teachers being conscious about the concept of bioeconomy in her following statement, "I thought about why I heard the term bioeconomy for the first time. This concept should be included in the Science Curriculum. If we, as teachers, were more conscious of this issue before it was included in the program, and then we could convey this awareness to the students", T6 indicated that teachers need to embrace the philosophy of the curriculum "The definition made in the first introduction to the science curriculum clearly declares to us that concepts such as bioeconomy and circular economy exist in the curriculum, and it is almost only up to the teacher's approach, if I understand the philosophy of that program rather than just the outcome dimension, I can integrate this concept into my course even if it is not in the learning outcome. Actually, we need to have the skills to update the curriculum here." and T3," It should already be in the science curriculum. Apart from the science curriculum, I think it is suitable for the acquisitions of many courses such as social studies and mathematics. It should be given with an interdisciplinary approach. I think it should definitely be in the social studies course for younger students. If we are going to change something, I think the beginning should be education. It would be great if this concept were included in the curriculum, children knew and applied it.", T5" I do not want the concept of bioeconomic to evolve into a science course only. Of course, the science course can have a weight, but I would like it to have an integrated approach, that is, it can be handled together with social studies, mathematics and Turkish courses with an interdisciplinary approach. Even more than the primary school level, this concept should be given in a way that is suitable for the level of the students and turns it into a skill with applied activities." and T8" We usually accustom children to problem solving. Since we are used to problem solving, we do not actually touch on these concepts much. The best environment this concept can be given is actually 3rd and 4th grade. The child is in touch with nature. If this concept can be experienced at an early age, you can instill this concept when you come to secondary school science class. Because children bring the knowledge, they received in primary school by magnifying it to you." In the statements mentioned above, teachers indicated that the concept of bioeconomy should be included not only in science courses, but also in different courses with an interdisciplinary approach, starting from small classes.

Discussion and Conclusion

In this study, which tries to determine the views of science teachers on bioeconomy, the findings are discussed as 3 main themes, "The concept of bioeconomy", "Bioeconomy and daily life" and "Bioeconomy in science classes". In this section, the results will be presented in accordance with these themes.

Under the first theme, the concept of bioeconomy, the teachers expressed their views on the concepts that the concept of bioeconomy evokes in their minds, the definitions of the concept of bioeconomy and the reasons for the emergence of the concept of bioeconomy. While only one of the science teachers who made up the study group knew about bioeconomy, it was seen that the other teachers heard the concept of bioeconomy for the first time, did not have knowledge about the concept of bioeconomy and had difficulty in defining the concept of bioeconomy. This finding is in parallel with the statement of Özkara and Keklik (2021) in their study, "Bioeconomy can be considered as a concept that is not emphasized much in formal education institutions in Türkiye and that, when first mentioned, offers an economic connotation, but it also has different scopes such as contribution to nature". Factors such as lack of resources, industrialization, population growth, economic developments, global climate crisis and environmental pollution, which science teachers see as the reason for the emergence of the concept of bioeconomy, seem to overlap with the global problems stated in the Lund Declaration (2015). While teachers with less seniority years drew attention to the ease of access to raw materials in bioeconomy, teachers with more seniority years explained the need for bioeconomy more within the framework of global problems.

Under the second theme, bioeconomy and daily life, the teachers expressed their views on the relationship they established between the concept of bioeconomy and the sustainable environment, and the relationship between "biological resources" and "biological-based products", which are the basis of the concept of bioeconomy, and bioeconomy with daily life. While Türkmen and Kılıç (2020) state that a good circular economy has come to an important point in building and designing a sustainable future, it was observed that even though Science teachers indicate the relationship between bioeconomy and sustainable environment, they had difficulty in explaining the relationship between bioeconomy and the concepts of “biological resources” and “biologically based products” and their connection with daily life. It has been determined that the teachers are aware of organic wastes, they do not have enough ideas about how to put organic wastes to good use, they follow the example applications in social media and news about the putting organic wastes to good use, but

they cannot relate these examples to bioeconomy. This finding is in parallel with the result of Harman and Kalaycı (2020) in their awareness study of science teacher candidates about zero waste approach, "Pre-service teachers think that it is not possible to recycle food and organic wastes even though recycling is possible". In addition, they expressed the areas where bioeconomy is used or can be used and the sectors covered by bioeconomy as agriculture, animal husbandry, textile, food, health, education and energy This finding is based on the definition made by Kiper (2013), as "The concept of bioeconomy includes different aspects such as chemistry, detergent, material, plastic, starch, paper, textile, leather, feed, active pharmaceutical ingredient, vaccine, cosmetics, energy, food additive and agriculture. It can be defined as the production of products with commercial value in sectors using biological tools and environmentally friendly methods." It demonstrates that the teachers express superficially the areas where bioeconomy is used or can be used and the sectors covered by bioeconomy.

Under the theme of bioeconomy in the science classes, which is the third and last theme, the teachers expressed their opinions about whether they include the concept of bioeconomy in their lessons and whether the concept of bioeconomy, which is not included in the science curriculum, should be included in the science curriculum. When the Science Education Program published by the Ministry of National Education in 2018 is examined, it is seen that the concept of bioeconomy is not included in the program The fact that the concept of bioeconomy is not included in the science curriculum leads to the conclusion that teachers do not have an idea about this concept and do not include this concept in their lessons. However, although the concept of bioeconomy is not included in the science curriculum, it has been determined that teachers try to associate the concept of bioeconomy with the concepts of recycling, environmental pollution, biodiversity, biotechnology, and sustainable development. The teachers who emphasize the concept of bioeconomy, which is put forward for the solution of global problems and plays a role in the economic development of countries, should be included not only in science courses but also in different courses and from small classes with an interdisciplinary approach, also mention that as Arslanhan (2012) stated the concept of bioeconomy should be included in the Science education program in order for our country, which has a richer biological resources and genetic diversity than many other countries, to meet its needs, to take an active role in the growing market, and to develop economic policies with environmentalist policies.

The results of the research show that most of the science teachers who make up the study group do not recognize the concept of bioeconomy, which was put forward for the solution of

global problems, do not include it in their courses in parallel with the fact that it is not included in the science curriculum, and they cannot relate this concept to real life problems. Thus, it is recommended that sustainable environmental education and bioeconomy education should be expanded for Science teachers who can play an active role in introducing and promoting bioeconomy to future generations, so that they can follow the ideas and practices put forward for the solution of global problems and include them in their lessons, and make sure that the concept of bioeconomy is included in the science curriculum, the concept of bioeconomy is introduced with an interdisciplinary understanding, starting from a young age.

The decision to "give importance to education, publication and publication activities in order to develop the human resources potential of the stakeholders" taken at the bio economy workshop (cited by Arısoy, & Avcı, 2020) held on June 20, 2013, shows the importance of education in popularizing the concept of bioeconomy, which is extremely important for a sustainable future and economic development in our county and promoting it to the future generations. It is thought that this study will be important in terms of guiding science teachers and researchers, who have an important role in bioeconomy education, in terms of bioeconomy education and research.

About Authors

First Author: Semih Esendemir works as a science teacher at Emine Emir Şahbaz Science and Art Center. He is also a graduate student at Eskişehir Osmangazi University, Department of Science Education.

Second Author: Burcu Anılan is an associate professor in Science Education. She is currently working at Eskisehir Osmangazi University, Faculty of Education, Department of Mathematics and Science Education. She has over 15 years of science and chemistry education experience. Her researchs interest lies in science education, chemistry, chemistry education, teacher training, teaching–learning processes in science education.

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ORCID

Semih Esendemir https://orcid.org/0000-0003-3657-034X

Burcu Anılan https://orcid.org/0000-0002-4153-1866

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