Understanding the life applications of green chemistry among students of the College of Education for Pure Sciences Ibn Al-Haytham in Iraq

Hassanein Ali Majid
hasanein.ali1205b@ihcoedu.uobaghdad.edu.iq
Prof. Basma Mohamed Ahmed
basma.m.a@ihcoedu.uobaghdad.edu.iq
College of Education for Pure Sciences/ Ibn Al-Haytham ,University of Baghdad , Baghdad Iraq, 10011

Abstract:
The research aims to know the degree of understanding the life applications of green chemistry. The descriptive research method was adopted. The research sample consisted of (250) students from the College of Education for Pure Sciences Ibn Al-Haytham (fourth stage) morning and evening studies for the academic year 2021/2022, i.e. (79) %) of the research community were selected in a simple random way, the research tool was a test of understanding the life applications of green chemistry from (24) items of the type MCQ, using the statistical package for social sciences (SPSS+22), to process the search results, the statistical results showed that the students have Weakness in understanding the life applications of green chemistry, and in light of the results, many recommendations were presented, most notably the integration of concepts related to the life applications of green chemistry within chemistry courses.

Keywords: applications of green chemistry, contemporary chemical concepts, sustainable chemistry.

Introduction:
The rapid progress in science and technology led to the development and increase in global economic growth, but this economic development also caused the deterioration of the environment (Sharma, 2019:202) which was manifested in climate change, drought, depletion of the ozone layer, loss of biological species in forests and water, pollution of fresh and marine waters, change Sea level and the spread of various diseases and human, environmental and economic damage and losses (Ismail, 2019: 91), so awareness of environmental protection has increased, as new laws aim to protect ecosystems from harmful chemicals and develop new compounds that are less dangerous to human health and the environment (Sharma, 2019: 202) A new chemical trend has emerged that is concerned with treating and disposing of pollutants and reducing the excessive consumption of resources and energy. It is called green chemistry. It is characterized by reducing the environmental damage associated with the production of chemicals through the proper disposal of waste generated during various chemical processes. Green chemistry is a new technology that aims To formulate, process and apply chemicals in a manner that minimizes risks to humankind and the environment (Saleh & Koller, 2018:3). And to produce non-polluting and safe materials through chemical reactions that invest all the materials involved in the chemical reaction and not produce unwanted secondary compounds, which contributes to reducing time and effort and reducing the cost of production and thus increasing development. (Abu Al-Wafa, 2018: 10) It is worth noting that there is a close relationship between green chemistry and sustainable development, and green chemistry can be described as sustainable chemistry because it is related to three aspects:

- Economic: It has a lower economic cost compared to ordinary chemistry.
- Materials: They call for optimum use of materials, recycling and reducing waste.
- Waste: through which it is possible to reduce or completely prevent unwanted byproducts. (Abu Al-Wafa, 2018: 8) Of course, green chemistry deals with environmentally friendly life applications in various fields, including green energy (renewable energy), which includes the energy of biomass, sun, water, underground heat, wind, waves and nuclear energy, in addition to green buildings designed in a way that reduces the consumption of resources and energy, including It is in harmony with the environment, and the production of compounds and materials that do not include raw materials that cause harm to humans and the environment (Husnia, 2020: 11). Among the life applications of green chemistry.

Hydrogen Energy:
The areas of hydrogen (H2) are widely used in many applications, including the industrial field, as in oil refining and ammonia production used in the fertilizer industry and the production of methanol. Which operate with cells (FCEVS) Fuel cell electric vehicles, which use hydrogen fuel cells, and hydrogen fuel also enters the operation of

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buses and trucks, and water is a natural resource rich in hydrogen, and hydrogen production has been divided into three groups depending on the amount of pollution that is produced during the manufacturing process and given special colors To distinguish it, it is represented by the first group: the amount of carbon emissions (zero or very low) in which hydrogen is made through the electrolysis of water and its colors are green hydrogen, pink hydrogen, yellow hydrogen and blue hydrogen, and the second group: the amount of carbon emissions (medium to high) and hydrogen is made from natural gas (CH4) or For biomass, as in turquoise hydrogen and gray hydrogen. Group III: The amount of carbon emissions is very high and hydrogen is made from coal as in black hydrogen and brown hydrogen (Mattis et al., 2020: 24-6).

Biogas:

It is derived from natural, biological raw materials, such as animal waste, plant waste, household waste, and industrial waste (Abdo, 2014: 26), and from sewage treatment plants. Solid organic waste and waste from the agri-food industry. (Ramirez .M. et al, 2015: 298), the production of biogas takes place inside anaerobic bioreactors by types of microorganisms such as fungi, bacteria and yeast, (Abdo, 2014: 30-31), and rural families can benefit from the biogas reactor In the field of cooking, heating, operating irrigation machines or generating electricity, the residues of the fermentation process are used as an organic fertilizer rich in beneficial elements for plants and free of microbes, making it a clean fertilizer that does not pollute the environment or add it to animal feed. (ESCWA, 2019: 16)

Bio-Ethanol:

It is one of the alternative renewable energy sources for fossil fuel energy, which can be used as a pure fuel bearing the symbol (E100) or as a mixture with gasoline fuel in internal combustion engines under the name “gasohol” in certain proportions, and contributes to reducing exhaust emissions. Cars that cause environmental pollution such as carbon dioxide CO2 and unburned hydrocarbons in addition to increasing the oxygen content in the fuel and thus increasing the operating power of the engines (Zabochnicka & Lucyna: 2010,243), and used to produce bioethanol as organic raw materials with low economic cost, such as agricultural residues that contain Simple and disaccharides such as honey and fruit and vegetable juices that contain sugars or polysaccharides such as starch and cellulose found in wood, grains and potatoes. (Assaf: 2017, 11)

Biodiesel:

Biodiesel is derived from the remnants of unusable edible oils such as soybean oil and other oils after their use in homes or restaurants, (Ayad, Bla: 26), but biodiesel derived from edible oil is not sustainable due to the high demand On oils in the food sector, it was therefore derived from agricultural waste because it contains many complex sugars (Saccharides) that are converted into fats (lipids) by the fermentation process by microorganisms (such as bacteria, yeast or fungi) and converted into methyl esters (diesel). Biodiesel) (Kukkala et al, 2021:269). Oils needed for biodiesel production can also be obtained from algae, as they produce oils based on photosynthesis (ESCWA, 2019: 18)

Bioplastics:

The term "bioplastics" refers to "biopolymers". According to the (IUPAC) International Union of Pure and Applied Chemistry, biopolymers are defined as “polymers naturally derived from living organisms or chemically synthesized from a renewable material, which can be used to replace conventional materials” (Mohan.D. et al, 2020). :4). The main source of bioplastics comes from natural sources, such as starch, cellulose, and proteins of plant and animal origin, and researchers at Symphony Environmental (a plastic technology company) were able to manufacture d2w, an additive designed to reduce the environmental impact of plastic products (Symphony). E, 2019:5) One of the advantages of the bioplastic resulting from the addition of (d2w) is that itConverts to biodegradable material in the open environment.

It meets all relevant international standards, and has the same characteristics as ordinary plastics in terms of strength and flexibility.

It becomes biodegradable within the approximate time range specified in manufacture, and has a long shelf life if stored properly, and will not degrade prematurely. (Symphony E, 2019:5)

Activated Carbon:

The European Chemical Industry Council (C.E.F.I.C) defines activated carbon as “carbonate materials with a porous structure that gives a large internal friction area. These materials are able to adsorb many compounds on their inner surface. These compounds are called adsorbents.” Camrashw, 2017: 31). Recently, research has directed towards preparing activated carbon from environmentally friendly raw materials such as agricultural waste, the most important of which is date kernels (dates) due to its presence in abundant quantities and cheap price compared to other environmentally friendly organic raw materials, and the idea of converting date nuclei into activated carbon

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has a direct impact on the recycling process. Agricultural waste to achieve development (Al-Sayed and Sharif, 2017: 65-66).

Smart Windows:

Smart glass is characterized by the ability to control the entry of sunlight, store solar energy falling on it and convert it into electrical energy, provide appropriate shade, and control temperature (Abdul Qader and others, 2017: 5), and among the smart window technologies are granule windows Hanging and electrochromatic technology (Naseer et al., 2021: 350–351), smart self-cleaning windows (Hasaballah, 2017: 70), and smart windows alternative to air conditioners (Ayad, Bla: 24)

Bioactive textiles:

It is a type of antibacterial fabric made from organic cotton fabric and used as an alternative treatment for many skin infections (Chirila .L. et al, 2020:55) and made of hollow fibers containing microorganisms of harmless bacteria. Or from genetically modified cells, these organisms work on analyzing dirt, removing odors and residual sweat in the fabric, thus making clothes that clean themselves by themselves, and this in turn leads to getting rid of washing machines and washing powders, reducing economic costs and increasing water savings. Medical bandages. (Ayad, Bla: 21)

Solanesol from tobacco leaf

Tobacco is one of the richest plant sources of Solanesol alcohol, which is included in the composition of antibiotics such as anti-inflammatory, anti-microbial and antioxidants. It is an effective material for absorbing free radicals. It is also used in the production of vitamin K2 and the production of coenzyme Q10 One of the antioxidants is also used in the treatment of heart disease and migraine headaches (Yan.N. et al, 2019:2)

Life applications are among the things that students learn within the educational institution and are applied in practical life, which affects the increase in students' motivation for science and the consolidation of information in their minds, as well as qualifying them to be researchers and producers in the future (Al-Ali, 2020), so from this point I started Universities direct researchers to conduct studies and scientific research in green chemistry, through which they search for environmentally friendly alternatives, and replace materials whose raw materials are based on oil derivatives as raw materials with environmentally friendly natural materials derived from agricultural and natural products so as to give the same efficiency as old products based on Petroleum in its manufacture, in addition to not causing pollution to the environment, as in the manufacture of plastics, cleaning materials, textiles and others (Ismail, 2019: 100), and Brown and others (Braun & et al., 2006) pointed out the importance of linking the concepts of green chemistry with the students' environment, as it works On developing communication skills, problem solving and decision-making ability, as well as building a sense of social and environmental responsibility and achieving sustainable development, (Braun & et al., 2006: 11 28), and Miller's study (Miller, 2012) recommended the necessity of including green chemistry and its applications in the curricula to build a scientifically educated generation capable of active participation in society, (Miller, 2012: 3) as the study aimed at (Cullipher, 2015). To prepare courses that include green chemistry in the curricula to develop students' skills in making the right decisions (Cullipher, 2015 4). In the same context, (Abu Al-Wafa, 2018) indicated the need for students to learn green chemistry because it contributes to improving their understanding of chemical principles and concepts, developing their scientific culture and achieving economic, social and environmental gains, as well as contributing to preparing future citizens who will have the responsibility to build a more sustainable society (Abu Al-Wafa, 2018). (2018: 11), and (Ismail, 2019) stressed "the necessity of selecting new green topics and including them in chemistry curricula for the various primary, secondary and university levels" (Ismail, 2019: 104). Contemporary trends in teaching call for providing university students in general and students of the College of Education in particular with all that is new in the scientific arena and providing them with information and contemporary scientific concepts and linking them with their daily practices that they need during university studies and after their graduation and performing the teaching profession in secondary schools. The trends that are emphasized are to create a model for a sustainable society within the university campus, by paying attention to the applications of green chemistry, which address the environmental reality, reducing or eliminating chemical pollutants, relying on non-polluting green alternatives, consuming small amounts of resources and energy, and exchanging opinions with a sample of Faculty members from the Department of Chemistry at the College of Education for Pure Sciences / Ibn Al-Haytham, University of Baghdad, about their interest in employing green chemistry and its life applications during teaching or updating the vocabulary of study subjects with these contemporary concepts, it was concluded that the concepts of green chemistry did not take a wide space in the content of courses Chemistry or its educational programs, and some interviews were conducted with a sample of the fourth stage students in the college And they confirmed their lack of knowledge of the life applications of green chemistry, and this was reinforced by a survey of the opinions of a

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random sample of (26) male and female students from the fourth stage of the Department of Chemistry at the College of Education for Pure Sciences / Ibn Al-Haytham - University of Baghdad, for the academic year 2021/2022 on an open questionnaire that included many Of the questions to confirm the interest in the life applications of green chemistry, the results of which showed a lack of interest in the global issues developed in the field of green chemistry applications, so the research problem crystallized by answering the question: What is the degree of understanding the life applications of green chemistry among students of the College of Education for Pure Sciences Ibn Al-Haytham in Iraq.

Research Aims:

The research aims to know: The degree of understanding of the life applications of green chemistry among students of the College of Education for Pure Sciences / Ibn Al-Haytham in Iraq.

Research Limitations

The search is limited to:

1- College of Education for Pure Sciences / Ibn Al-Haytham - University of Baghdad.

2- Students of the Chemistry Department - the fourth stage (the morning and evening government studies).

3- The academic year (2021-2022).

define terms

Life applications of green chemistry, defined (S. Kaul, 2017): "Adherence to the principles of green chemistry and benefiting from its advantages in daily life" (S. Kaul, 2017: 144).

Procedural definition: The ability of students of the Department of Chemistry (fourth stage) from the College of Education for Pure Sciences / Ibn Al-Haytham, to realize the meanings and dimensions of dealing with clean alternatives and benefiting from their advantages in daily life, represented by (hydrogen energy, biogas, bioethanol, biodiesel, plastic Bio, activated carbon, smart windows, bioactive textiles, solansol from tobacco leaves) and it is measured by the degree that students obtain in the test prepared for this purpose.

Search procedures

Research Methodology: The descriptive research method was adopted to suit the research objective and problem.

The research community :Theresearch community consisted of all the students of the fourth stage of the Chemistry Department in the College of Education for Pure Sciences Ibn Al-Haytham in the morning and evening studies, amounting to (318) male and female students, (171) males and (147) females.

Research sample: A random sample of (250) male and female students was selected from the research community at a rate of (79%).

Research Tool: Testing Life Applications of Green Chemistry: The following steps were followed:

Determining the objective of the test: measuring the knowledge and skills concerned by following the best ways to reduce waste and consumption of resources and energy and reduce pollution by dealing with clean alternatives.

Determining the biological applications of green chemistry:

determined by (hydrogen energy, biogas, bioethanol, biodiesel, bioplastics, activated carbon, smart windows, bioactive textiles, solansol from tobacco leaves).

Formulation of test items with its instructions: The test items were formulated in the form of a multiple choice with four alternatives, with a total of (24) items, and the total score was determined in the range (0 _ 24). Its apparent sincerity was verified after it was presented to a group of arbitrators in the field of pure chemistry.

Statistical analysis of test items:

The test was applied to a statistical analysis sample of (250) male and female students, who were chosen in a relatively simple random manner from the students of the Department of Chemistry fourth stage - College of Education for Pure Sciences / Ibn Al-Haytham. The coefficient of difficulty was calculated for each of the test items by applying the coefficient of difficulty of the objective questions and it was found that it ranges between (0.41-0.71) and all the test items were good and their difficulty coefficient was appropriate. Objectivity and it was found that it ranged between (0.40 - 0.60) and all test items were of acceptable discrimination, and the effectiveness of all wrong alternatives was found to be negative. A good indicator of test stability and item consistency and homogeneity. Also, the Split-Half Method was used to calculate stability. The 24 test items were divided into two halves, and the correlation coefficient (Ber) was calculated. Son) between the two halves of the test, and the reliability coefficient in this way was (0.70), which represents half of the correlation, and after correcting it with the Spearman-Brown formula: it reached (0.82), which is a good stability coefficient, and thus the test is ready to be applied to the research sample.

Presentation of the results:

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After calculating the scores obtained by the students in the test of understanding the life applications of green chemistry, the T-test for one sample was adopted, Table (1).

Table (1) One-sample t-test for the difference between the arithmetic mean of the sample and the hypothetical arithmetic mean to test the understanding of life applications of green chemistry (Source: Prepared by the researcher)

The meaning of the difference	indicative level	T value		Hypothesis mean test	standard deviation	The arithmetic mean of the sample	Sample	Variable
		Tabular	Calculated					
insignificant	0.05	1.960	-17.474	12	3.538	8.088	250	Understand the life applications of green chemistry

It is evident from Table (1) that the calculated t-value (17.474) is smaller than the tabulated t-value (1.960) at a significance level (0.05) and a degree of freedom (249), and there is no statistically significant difference between the arithmetic mean of the sample and the hypothetical average of the test, meaning that the students have Low understanding of the life applications test of green chemistry.

Discussion of Results:

The statistical results showed that the fourth stage students of the Department of Chemistry in the College of Education for Pure Sciences / Ibn Al-Haytham have a low level of understanding of the life applications of green chemistry, and they can be discussed as follows:

When referring to the test of understanding the life applications of green chemistry, it was found that 80% of the sample did not have a clear understanding of the importance of biogas production and its use as an alternative to fossil fuels, and that 87% of the sample could not explain the use of algae as a green alternative to fossil fuels in biodiesel production. 81% of the sample realize that improving the quality of plastic production and converting it into a substance that quickly decomposes in the environment requires adding new chemicals to it, and the sample did not develop an understanding of the applications of solansol from tobacco in life, as 84% showed their lack of awareness that extracting alcohol Solansol from tobacco is used as an application in the manufacture of medical and pharmaceutical materials and the production of vitamin K2, and the reason is due to the nature of the educational programs offered to students of the Department of Chemistry that do not contain chapters or topics related to the study of green chemistry and its applications. 2019) "The study of green chemistry contributes to preparing a generation of chemists who possess the skills and knowledge necessary to practice environmentally friendly chemistry through educational materials related to green chemistry (S). Mael, 2019: 140), and this weakness can also be attributed to the students' lack of knowledge of the latest developments in chemistry and their neglect of scientific research, especially those dealing with green chemistry topics, as well as the lack of participation in educational seminars held by the university in a way that enhances the culture of green chemistry and learn about its applications. She indicated (Al-Enezi, 2016) "The university has a prominent role in preparing student activities according to the interest of the faculty member and in various fields, and carrying out applied research and holding seminars and training courses in a way that serves the community and students" (Al-Enezi, 2016: 626). This result is compared with the results of previous studies, because no previous studies were found to understand the life applications of green chemistry (within the researchers' knowledge).

Conclusions:

According to the research results, it was concluded that the students of the Department of Chemistry in the College of Education for Pure Sciences / Ibn Al-Haytham have a low understanding of the life applications of green chemistry.

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Recommendations: In light of the results, the researchers recommend the following:
1. Including the life applications of green chemistry within the chemistry courses in the College of Education for Pure Sciences / Ibn Al-Haytham to introduce students to green chemistry and benefit from the experiences of countries that preceded us in these fields.
2. Assigning students of the College of Education for Pure Sciences/Ibn Al-Haytham to prepare researches related to green chemistry in a way that increases their culture and builds positive tendencies and attitudes.
3. Organizing courses for teaching staff to train them on how to employ green chemistry topics and its applications in education and to clarify its role in the growth of students' economic, social and environmental awareness.
4. Organizing scientific field trips and visits that make the students of the College of Education for Pure Sciences/Ibn Al-Haytham come into contact with their environment.
5. Organizing seminars and conferences to introduce students to the College of Education for Pure Sciences / Ibn Al-Haytham, raise their awareness and educate them about green chemistry, and turn them into practical practices that contribute to preserving the environment.

Suggestions:
To complement the current research, the researcher proposes a set of the following studies:
1. Conducting a study dealing with understanding the life applications of green chemistry among students of the College of Education for Pure Sciences / Ibn Al-Haytham according to the gender variable
2. Conducting a study dealing with awareness of the dimensions of sustainable development and its relationship to green technology.
3. Conducting a similar study on another academic stage.

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