Research Article

Awareness of the principles of green chemistry among middle school teachers

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Abstract: The current research aims to recognize awareness of the principles of green chemistry among chemistry teachers and to recognize the significance of differences in awareness of the principles of green chemistry according to the sex variable and the research identified the chemistry teachers in the preparatory schools of the Directorate of Diwaniyah Education, for the academic year 2020-2021 and the sample size (130) teachers and schools randomly selected. To achieve the objectives, The results showed that chemistry teachers do not have awareness of the principles of green chemistry and the absence of differences for the sex variable, and the researchers recommended in the light of the results many recommendations and proposals.

Keywords: Awareness, principles of green chemistry, middle school teachers.

Research question

Human actions have had a serious and negative impact on the ecosystems of our planet. Humans need to be highly aware of these problems and move towards reducing them. Green chemistry is one of the main scientific solutions to drive and reduce this deterioration, as the world has begun to resort to it and take care of it and its principles because of its importance in developing many learning outcomes, the most important of which is the development of environmental awareness. Therefore, awareness and knowledge of the principles of green chemistry is a necessary need and a positive step in the right direction to consolidate environmentally friendly experiences and reduce damage to the environment, and to contribute to the dissemination of this modern trend of science, we need those who address, and the best one who plays this role is chemistry teachers. According to the practical experience of the researchers in the field of teaching for more than fifteen years, they noted that a large proportion of teachers lack awareness of the principles of green chemistry because of their closure of the course and the absence of a seminar or role in this field.

To confirm this, the researchers prepared an open questionnaire, in which they developed a set of questions about green chemistry and its principles. Through the results of the questionnaire, it was found that there are:

-100 %of teachers do not know the term green chemistry.

-100 %of teachers do not know the principles of green chemistry.

In light of this, the idea of the current research was launched, and the researchers were allowed to identify the problem with the following question:

-Do chemistry teachers have an awareness of the principles of green chemistry?

The importance of research:

Chemistry has contributed to the greatest role in the cultural renaissance of various fields of life, which provided well-being such as meeting his various needs, through which man was able to convert raw materials to other images such as dyes, drugs, and perfumes to meet him, as well as contributed to the medical revolution by eliminating many diseases and producing pesticides and industrial fibers. (Manahan, 2006:2).

Because of the wastefulness and scarcity of environmental sources and industrial activity, a new style of chemical techniques emerged and took several names, including green or clean chemistry. This indicates that chemistry is not only concerned with the properties or effectiveness of the resulting substances, but also the consequences associated with chemical processes. (Ahmed and Najla, 2010:2).

Green chemistry has an important role to play by making chemistry an integrated science by reducing and reducing the resulting pollution caused by chemical manufacturing in all fields of medicine, petroleum, and plastic.

Green chemistry is, therefore, an ideal way to eliminate pollution problems in a healthy, effective, and cost-effective manner, through the applications of some of its principles such as reducing waste, using catalysts instead of using safe solvents, and chemicals that decompose after use rather than accumulating them in the environment. (Ablan, 2006:4(

The importance of green chemistry can also be attributed to maintaining a balance between the surrounding environmental needs and the requirements of modern life, reducing the oil industries generating toxic substances harmful to the environment, and reducing the demand for some non-renewable resources. (Al-Shahri, 2019:239)

The importance of green chemistry is also highlighted in the fact that it seeks to develop awareness among the teacher of societal issues and problems and how to employ creative solutions for green chemistry in addressing

and reducing these problems, working to preserve the environment, maintaining its integrity, and achieving green chemistry interconnection and integration between different branches of chemistry. (Mohammed, 2020: 239)

As a leader and social leader in his school, environment, and community, he is the influencer and the vector of experiments, so his main role in translating his experience to create a green society that believes in preserving the environment through the principles of green chemistry is the point of connection between society and its intentions represented by students and green chemistry. (Rioan, 2018: 31)

There are aspects of interest in the principles and applications of green chemistry, including the establishment of several conferences, seminars, and workshops, where the Center for Environmental Research at Babylon University in 2013 held a scientific symposium on green chemistry and the establishment of the Department of Chemistry in the Faculty of Education for Girls / University of Baghdad scientific symposium in the department of chemistry entitled Green Chemistry and its modern techniques as well as the establishment of a faculty Education for science at Diyala University in Iraq seminar on (green chemistry) with the participation of several researchers and specialists as well as a workshop complex on different types of chemicals and how to deal with them and avoid their risks under the slogan (security and chemical safety and the role of green chemistry) at the Technical University in Basra, Iraq. There are international initiatives to raise awareness of green chemistry and widely where they are encouraged by governments and institutions as well as industrialists in many ways, including the Research Network (Europe), the Institute of Green Chemistry (UNITED States), the Green and Sustainable Chemistry Network (Japan) and other collective initiatives, as well as the approval of many universities in the world to integrate the principles of green chemistry into their curricula as well as the recognition of different chemical communities as a key research area for their magazine. The Royal Society in the UK has represented a magazine called Green Chemistry and exclusively to cover research in this field. (Sanghi & Singh , 2012 : 18).

Researchers can summarize the importance of research with the following points - :

1-The current research is the first of its kind locally and Arably, according to the researchers, which deals with a completely modern variable, which is awareness of the principles of green chemistry.

2-The importance of chemistry for preparatory stage students because it is part of experimental sciences that help to absorb science and explain phenomena of situations formed in life, and this, in turn, confirms the importance of chemistry teachers in the preparatory stage having information about green chemistry.

3-The results of the current research may contribute to directing the attention of officials to the development of the chemistry curriculum for the preparatory stage in a development commensurate with the size of global developments and trends that are characterized by change and rapid development or contribute to the preparation for complementary research in the field of principles and applications of green chemistry.

Search goal :

The current research aims to :

1-Identify awareness of the principles of green chemistry among chemistry teachers for the preparatory stage.

2-Identifying the significance of differences in awareness of the principles of green chemistry in the teacher of chemistry for the preparatory stage according to the sex variable.

Search limits

The current research is determined by chemistry teachers for the preparatory stage in the Al-Qadisiyah governorate for the academic year (2020-2021)

Search terms

-**Awareness knew by**:

Jouce (1990): "It means the characteristic of possessing knowledge and knowledge." (Jouce, 1990: 51)

Al-Basha (1992): "Awareness means understanding and the integrity of perception, it is in the individual and the community." (Pasha, 1992: 1101)

Green chemistry known by :

(Anastans, 2009) uses a set of principles that reduce or prevent the use or generation of hazardous materials in the design, manufacture, and application of chemical products. (Paul T Anastans ,et al , 2009 : p50).

Arafa (Seldon): This is the use of raw materials (preferably renewable ones) to prevent residues and to avoid the use of toxic and dangerous reagents and solvents in the manufacture and application of chemical products. (Sanghi R & Singh v., 2012: 9).

-The researchers know the awareness of the principles of green chemistry procedurally: the knowledge needed to adopt the principles of green chemistry and to form a comprehensive perception of it among chemistry teachers in the preparatory stage and measured to the degree that the teacher receives on the scale of awareness of the principles of green chemistry prepared for this research.

Theoretical background

The concept of awareness

Awareness is the result of several complex mental processes, where awareness generates experience in the individual and society and has the task of determining the moment of starting work. Awareness contributes to the formation of a solid knowledge base from which a bridgehead is taken to overcome the difficulty of absorbing the vocabulary of existence. Awareness depends on the mental image as an important means of archiving and organizing experience with the external environment. Awareness may sometimes suffer from the slow follow-up of reality and society, and this may be due to traditions or fear of change and the variables that awareness must respond to, program, and organize its ability to address the vast abundance of information and cosmic communication. (Bakar, 2000: 9-13)

Levels of awareness

Awareness directly affects the formation of behavior, so the resulting actions will be positive or negative to the degree of this awareness in terms of depth and honesty, hence the concept of levels of awareness.

1 -Full awareness: which is the realization of importance, seeking to find the greatest knowledge on the subject of awareness, developing positive behavior consistent with the perceived importance, then implementing this behavior in actual reality and then evaluating and following up on the positive changes that occur by behavior. Therefore, full awareness goes through steps such as awareness, gathering information, and adapting to the situation in a new way.

2 -Incomplete awareness: It is an awareness that understands the importance, without any action or reaction that is compatible with the realization of importance. Awareness is incomplete when it is not followed up and evaluated for the results of the actin creating the target interpretation of awareness .

3 -Honest awareness: an awareness in which behavior is consistent with the perception of importance, and therefore the behavior achieves positive results and this is concerning the goal of awareness.

4 -False awareness: an awareness in which the realization of the importance of the subject is not real, such as the perceived importance is not important or exaggerated. Awareness is also false in the case of behavior that is contrary to consciousness or importance.

5- Skilled awareness: it is the awareness that increases abilities both at the individual and collective level and in which the individual or individuals are in constant attention. It recognizes the importance, monitoring, interpreting, and understanding variables and this leads to the building and performing of actions leading to the development and adaptation of capacities. (Mustafa, 2016: 129-131)

Green chemistry

Some believe that the concept of green chemistry is synonymous with the concept of environmental chemistry, knowing that both seek to make the world safer and a better place, each complementing the other, but environmental chemistry means environmental sciences, which specialize in five main areas: the aquatic atmosphere, the atmosphere, the earth's atmosphere, and the biosphere.

Human activities, which carry out undesirable pathways in the four areas, causing pollution and problems for the environment, while green chemistry seeks solutions to these problems through the use of alternative resources and environmentally safe technology, aimed at preventing pollution from the beginning rather than addressing it after its formation. (Manahan, 2006 :3)

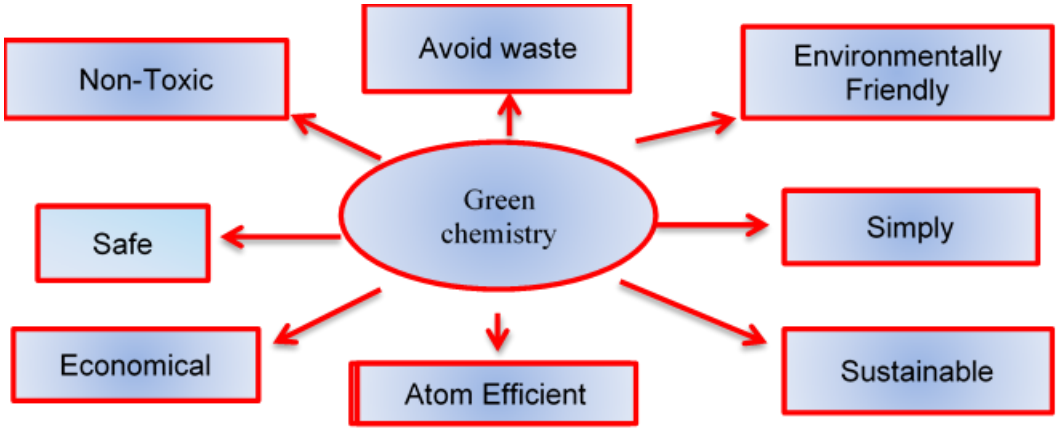
The concept of green chemistry is not determined by the fact that it is a branch of chemistry that is interested in designing safe chemical processes, but rather expands the meaning to maintain the requirements of current generations without affecting or draining the future needs of generations of different natural resources and to bear the environmental burdens that may be inherited from previous generations in the event of misuse of these resources and green chemistry is linked to several aspects, including :

Economic economy Means low economic cost compared to chemistry.

Waste loss: This means reducing or preventing unwanted by-products as much as possible.

Materials: In the sense of optimal use of raw materials, maximizing recycling and reducing waste. (Horvath&Anastas, 2007:217)

According to (Hajjaj, 2020), there are two main trends in what is the concept of green chemistry. (Hajjaj, 2020: 32-34) When green chemistry means that no hazardous substances are generated in manufacturing, it is based on its 12 principles, so we can determine its characteristics as a planned (1): (O'Brien, et al, 2009:1)



The genesis of green chemistry

When the "Pollution Prevention" Act, introduced by Congress in 1990 and then adopted by the Environmental Protection Agency, was the first and only law focused on pollution prevention aimed at protecting the environment by reducing harmful emissions from the same source. Under the law, the U.S. government has provided grants for the development of chemical products through various institutes and universities to reduce the risk of such substances, and the objectives of grants for the production of chemicals have evolved to equate harmful substances, reduce pollution and develop alternatives to chemicals produced from environmentally polluting extractions. (Tundo, et al, 2002:1209)

In 1991 and 1992, the Green Chemistry Program was established, developing many methods of green chemistry and environmentally benign chemical reactions.

In 1995, EPA received support from the then President of America to establish an annual awards program for scientific innovations for both academics and industrialists, which led to the advancement of green chemistry, which became the main platform for promoting awareness of green chemistry, and in 19 The University of Massachusetts at Boston was awarded its first Ph.D. in green chemistry, and in the same year, with the contribution of EPA, Dr. Joe Breen and chemist Dennis Hagerson founded the Green Chemistry Institute (GCI) is an independent, non-profit institution to work towards progress in green chemistry.

Paul Anastas and John Warner also wrote a book entitled "Green Chemistry: Theory and Application" and developed twelve principles to help chemists activate the concept of chemistry and environmental protection, as well as to provide companies with their long-term expenses by reducing the cost of monitoring pollution and lower energy consumption. (Anastas & Warner ,2000 :14).

Principles of Green Chemistry

In 1998, scientists Anastas and John Warner developed twelve principles of green chemistry, theory, and practice, published by Oxford University in Britain, twelve principles of green chemistry.

The first principle: prevention: preventing the formation of waste is better than treating it and disposing of it later.

Principle 2: Corn Economy: Any design of methods that lead to the integration of all materials used for the process into the final product.

Principle 3: Less dangerous chemical industries: As far as possible, synthetic methods must be designed to use and produce less or no toxic substances for human health and the environment.

Principle 4: Safer chemical design: Chemical products must be designed to retain their functional effectiveness and be less toxic.

Principle 5: Safer solvents and auxiliary factors: auxiliary substances such as solvents, separation sheets, etc.) Should be dispensed with as much as possible or safe when used.

Principle 6: Energy efficiency design: Energy requirements must be distinguished by their environmental and economic impact and should be as low as possible, industrial methods must be carried out at moderate temperature and pressure.

Principle 7: The use of renewable resources: raw materials and resources must be renewable and not exhausted whenever possible technically and economically.

Principle 8: Reducing unnecessary derivatives (closing totals, protection, de-protection, temporary modification of physical and chemical processes) must be minimized or avoided as much as possible because these steps need additional materials and can produce waste.

Principle 9: Catalysts: Stimulating reagents (as selective as possible) outperform traditional reagents.

Principle 10: Decomposition Design: Chemical products that disintegrate when they are finished must be designed into safe materials and not left in the environment.
Principle 11: Immediate analysis of pollution prevention methods requires further development to enable them to immediately decompose, control and control before the formation of hazardous substances.
Principle 12: Safe chemistry for accident prevention: Substances involved in the chemical process must be selected to reduce the likelihood of chemical accidents, such as proliferation, explosions, and fires. (Sanghi & Singh , 2012 : 10-11) .

Green Chemistry Applications
Paper industry :
Wood contains about 70% sugars and the rest represents the accent and the accent is completely disposed of to get the quality of the desired good paper, and the method of disposing of the accent is done by putting small parts of the wood in a bath of sodium hydroxide and sulfide Sodium, in this way removes approximately 80% of the accent and the rest is disposed of with chlorine gas with it, and the resulting paper is of good quality and white color, but in this way, the use of chlorine is harmful to the environment where it generates carcinogenic compounds represented by dioxins They are ring aromatic compounds, and today's modern method uses green catalysts (enzymes and antibodies) that add the paper paste to get rid of harmful carcinogens and get paper of the same good quality. (Ahluwalia & kid was, 2004: 15)

Pharmaceutical and medical industry:
Nobel scientists have discussed topics related to the chemistry of life, such as British scientist John Ernst Walker, Nobel laureate of chemistry in 1997, on the fuel of human life, represented by the chemical compound Adenosine triphosphate, which is produced by oxidation of energy-filled food compounds in several steps, the most important of which is conducted within the bites of the mitochondria, and John Angst explained that any malfunction in the power generation process is responsible for several diseases such as cancer .
As for new drug discoveries, 2012 Nobel Laureate Brian Kabika spoke about a cellular future called the future associated with protein G, which is responsible for delivering the majority of cellular responses to different chemical compounds such as medicines.
This question is the title of Israeli lecturer Harun Chekhanover, who won the Nobel Chemistry In 2004, which was recently demonstrated by scientists about the uniqueness of each patient's development and the different response of each patient to the same drug, which means that it is necessary to move from one drug age suitable for all to the age of personalized medicine where each patient has his treatment according to his or her condition and unique genetic material, but Chikhanovir expressed concern about the emerging ethical problems of not protecting individuals' genetic information and violating their privacy. (Jindal, 2018:227-228)

Green chemistry and chemistry teachers:
Green chemistry is one of the effective tools that work to reach the so-called green education, where most of those interested in the environment agree on several basics on which the educational process is based, namely that the teacher provides the opportunity for students to develop and maintain the personal link with the environment and also that education is a link between human activities and ecosystems, all members of society in a state of continuous dealing with other organisms such as clothing, food, and other things if learners reach understanding and knowledge of this interdependence and impact, will work This is to change their inappropriate practice and adopt positive behavior to preserve biodiversity and maintain improved life on earth, but for the role of teachers they must be facilitators of research and the imposition of learning and be involved in modern explorations and trends in chemistry. (Karpudwan , Ismail & Mohammed , 2011 : 43).
Many countries have relied on the inclusion of green chemistry and its principles and applications in its study programs and for all educational stages, especially university, in the United States of America green chemistry is raised by introducing activities in the curriculum, and teachers are trained in modern methods and how to integrate them with the rest of the sciences, as well as workshops with the help of websites and educational magazines to facilitate the concepts of chemistry and understanding the chemical risks in the surrounding environment. (Habibi, sabbaghanb & Mohammad, 2013: 290).

Research methodology and procedures
The research design is a plan to determine the research levels and statistical analysis of the plan and contains several interrelated measures such as data collection and analysis, hypotheses testing, and utilizing the right changes to predict relationships.
(Brodens & Abbott , 2014 : 99-100)
The researchers, therefore, chose the design of descriptive research to measure and describe awareness of the principles of green chemistry in the chemistry teachers of the preparatory stage.

The research community and its sample

Research community: The term community refers to the large group that the researchers want to generalize the results of their samples, i.e. the whole group that we care to know more about. (Johnson & Christensen, 2019:254). The current research community consists of all 250 chemistry teachers in state preparatory schools in Qadisiyah province.

Research Sample: The sample is part of the society in which the study is conducted, and the researchers choose it to conduct its study on it, and this sample must be generalized to the community. (Al-Azzawi, 2008: 161). For the sample to be representative of its original community, the researchers took a sample of chemistry teachers from the departments of the General Directorate of Education of Qadisiyah and randomly and proportionally, which is a size (130) teachers and schools.

Search tool

The researchers adopted the construction of a measure of awareness of the principles of green chemistry and it was applied to the research sample after extracting its econometric properties and to ensure that none of the members of the statistical analytical sample was included in the research sample.

The measure of awareness of the principles of green chemistry

The researchers identified awareness of the principles of green chemistry as a variable for current research, and the researchers were informed of several studies, sources, and research on green chemistry, but these studies did not provide a measure of awareness of the principles of green chemistry, so the researchers built a measure of awareness of the principles of green chemistry according to the following steps :

1-Determining the goal of the scale: the goal is to measure awareness of the principles of green chemistry in the chemistry teachers of the preparatory stage.

2-Determining the principles of green chemistry: by looking at literature and previous studies, the 12 principles of green chemistry have been adopted: prevention, corn economy, less dangerous chemical industries, safer chemical design, safer solvents, and auxiliary factors, energy efficiency design, use Renewable resources, reducing derivatives, catalysts, replacement design, immediate analysis of pollution prevention, and safe chemistry for accident prevention, where principles have been regarded as key issues of the scale and sub-issues of each principle have been identified, through the literature on green chemistry and studies. (Pilgrims, 2020 .(

3-Drafting the paragraphs of the scale: the paragraphs of the scale were formulated to suit the level of chemistry teachers in terms of clarity and ease of language, and the scale consisted of (48) paragraphs distributed on the twelve principles where each principle includes (4) paragraphs. The researchers relied on the teaching methods recorded by the arbitrators and in analytical, organic, inorganic, and industrial chemistry, curricula, measurement, evaluation, and educational psychology, and after taking their opinions, the scale became ready in its initial form.

4-Scale instructions: The researchers prepared the instructions of the scale to explain to the teachers of chemistry how to answer the paragraphs of the scale, and the instructions were clear, where the answer to each paragraph of the scale of five alternatives (I strongly agree, agree, I agree to some extent, I do not agree, I do not agree strongly) The following weights was given to a quantitative number to conduct statistics (5, 4, 3, 2, 1) for paragraphs so that the total score of the scale (240) became a hypothetical average (144), and the final score of the scale was calculated by collecting the total score For every teacher and school.

5-The first exploratory application: The researchers conducted the reconnaissance experiment, the aim of which is to identify the clarity of the instructions and paragraphs and the appropriateness of the proposed alternatives and to calculate the time needed to answer from During the application of the scale to a sample consisting of (20) teachers and schools, the researchers calculated the time taken to answer and found that the average (30) minutes, thus proving the time (30) minutes at a higher level.

6-Virtual honesty (presentation of paragraphs to arbitrators): To verify the sincerity of the virtual scale presented to a group of experts and arbitrators based on the observations and proposals they recorded on the paragraphs of the scale, the researchers amended and reformulated some paragraphs and then calculated the value of the Kay box for each paragraph and compared it with the table value (3.84) and freely (1) and the level of significance (0.05). The results showed that all the paragraphs were ostensibly honest.

7-Survey application II: After the procedures of the first exploratory application, the researchers applied the scale for the second time to a selected sample in the random selection method consisting of (100) teachers and schools.

8-Statistical analysis of the paragraphs of the measure

A- The strength of the distinction of the paragraphs of the scale: The researchers used the T-test of two independent samples to calculate the significance of the differences between the average groups in the grades of each paragraph of the scale, on the basis that the calculated T value represents the discriminatory strength of the paragraph where the results of the calculation of the distinct strength of the paragraphs are shown, All paragraphs are characteristic of being a statistical function because their calculated T value is greater than the t-

table value of 2.00 freely (52) and at an indicative level (0.05). Internal consistency (paragraph sincerity): Internal consistency has been calculated as follows:

1- The relationship of the degree of the paragraph to the overall degree.

In calculating the sincerity of the paragraph, the researchers relied on the Person correlation coefficient between the grades of each paragraph and the total score, because the paragraph grades were connected and graded, and the results showed that all transactions ranged from (0.210-0.791) to statistical function because they were higher than the scheduling value of (0,196) freely (98) and at an indicative level (0.05).

2-The degree of the paragraph relates to the degree of the main principle to which it belongs and the relationship of the degree of a paragraph to the degree of sub-issues of each principle and the relationship of sub-issues to the main principle. To calculate the value of the correlation factor between the paragraph grade and the total degree of the principle to which it belongs and the sub-issues of each principle, the Pearson link coefficient was used, and it was found that all correlation transactions were statistically functioning at the level of indication (0.05) and freely (98) and that their scheduling value was equal to (0.196)

3-The matrix of internal correlations to the independence of the main principles

To determine the independence of the main principles in its measurement of the concept of awareness of the principles of green chemistry, internal correlations were found between the overall degree of the scale and the overall degrees of principles. In their calculation, the researchers relied on Pearson's coefficient. It turns out that all the correlations between the principles and each other or their association with the overall degree of awareness of the principles of green chemistry and the use of Pearson's coefficient were statistically indicative at a level of significance (0.05) and freely (98) where the critical value is equal to (0.196), indicating that the principles are interrelated and measure one thing and are treated as a single college score.

C. Fortitude To verify the stability of the scale, the researchers used the Alpha-Cronbach equation: Cronbach's Alpha

The Alpha-Cronbach coefficient is one of the most common consistency transactions. (Christensen et al, 2015: 156).

The researchers extracted stability in this way from the grades of the 100 basic sample forms, using the Alpha-Cronbach equation, which amounted to an alpha coefficient (0.80), which is a good stability factor .

Results

The first goal is to learn awareness of the principles of green chemistry among chemistry teachers for the preparatory stage. To achieve this goal, the researchers applied the Green Chemistry Principles Awareness Measure of (48) paragraphs to the research sample consisting of (130) teachers and schools. The results of the research showed that the computational average of the grades of this sample on the scale was (143,338) degrees and with a standard deviation of (27,765) degrees, and to know the indication of the difference between the mathematical average and the hypothetical average of (144) degrees, the researchers used the t-test of a sample One shows that the difference is statistically non-D, with the calculated T value (0,272) smaller than the table T value of (1.96), at the indicative level (0.05) and freely (129), which means that the research sample does not have awareness of the principles of chemistry Green and Table 1 explains this.

Table (1). Arithmetic average, standard deviation, and T value of the measure of awareness of the principles of green chemistry

Indication (0,05)	**T-value***		**Hypothetical average**	**Standard deviation**	**Arithmetic average**	**Sample**	**Variable**
	Scheduling	**Calculated**					
Non-function	**1,96**	**0,272**	**144**	**27,765**	**143,338**	**130**	**Awareness of the principles of green chemistry**

The second goal is to identify the differences of statistical significance in awareness of the principles of green chemistry in the chemistry teachers of the preparatory stage depending on the sex variable.

To verify this goal, the researchers took the responses of the research sample of 130 teachers and schools on the measure of awareness of the principles of green chemistry, and after statistically processing the data, the researchers extracted the average degrees of sample members on the scale according to sex (male and female) and found that the average male score (142.39) 7) with a standard deviation of (31,285), and average female scores (144,224) with a standard deviation of (24,200), and to identify differences between males and females, the researchers used the T-test for two independent samples. The results were as described in Table 2.

Table (2). The following test of two independent samples to indicate the difference in awareness of the principles of green chemistry depending on the sex variable

Indication level (05,0)	T- value		Standard deviation	Arithmetic average	Number	Gender	Variable
	Schedulin g	Calculate d					
Non-function	1,96	0,374	31,285	142,397	63	males	Awareness of the principles of green chemistry
			24,200	144,224	67	Female	

The table above shows that there are no statistically significant differences between males and females in awareness of the principles of chemistry Green T calculated value (0,374) is smaller than the table T value of 1.96 at the indicative level (0.05) and the degree of freedom (128).

Interpretation of results

The results showed that chemistry teachers did not have awareness of the principles of green chemistry, and the results showed no effect on the sex changer, due to several reasons:

1-Many seminars and courses for chemistry teachers are deficient in addressing new topics such as green chemistry, its principles, and applications.

2-Teachers come from one environment and study the same (preparatory) stages and therefore there were no gender differences.

3-The nature of activities or courses offered to teachers and teachers is limited to the curriculum as well as the preparatory curriculum does not contain topics or classes related to the principles of chemistry and its applications.

4-Neglecting chemistry teachers to develop and develop themselves by looking at the new and new in the field of chemistry and not reading articles and scientific research on green chemistry.

5-There are matters related to green chemistry itself, it needs education and a guide for the teacher to follow, support for the skilled side, government and community encouragement, and green chemistry itself needs to be piloted, science does not learn independently of its applications and this has to do with the environment and society in which the learner lives (Ambo Saidi and Suleiman, 2018: 77).

Recommendations :

In light of the results, the researchers recommend several points:

1- Directing the attention of chemistry teachers towards green chemistry.
2- Select experiments and activities that urge the preservation of the environment, especially those that follow the principles of green chemistry.
3- The needs to hold training courses and programs for chemistry teachers during service to inform them of the latest developments in the world and the requirements of the era related to chemistry.
4- The needs to update the chemistry curriculum for the preparatory stage by the principles of green chemistry and its applications.

Propositions

The researchers suggest :

1- A proposed unit in the light of the principles of green chemistry and its impact on the development of 21st-century skills among fifth applied students.
2- Evaluating the chemistry curriculum in the preparatory stage in light of green chemistry

References

1. Ablan, C. (2006). Green chemistry and the role of carbon dioxide, as a solvent in catalysis, unpublished doctoral dissertation, University of Hawaii, Manoa.
2. Ahluwalia , V.K. & kidwai , m. (2004) . New trends in green chemistry. India: Ananya publishers, New Delhi.
3. Ahmed, Tawfiq Mohammed, and Najla Mohammed Lotfi, (2010), "Green Chemistry in the Arab Countries", Mediterranean Green Chemistry Network on the official website of the International Organization for Applied Chemistry and MeGRE, IUPAC.
4. Al-Azzawi, Rahim Younis (2008), introduction to the scientific research curriculum, Tigris Publishing House, Amman.
5. Al-Basha, Mohammed Al-Kafi, (1992), "Modern Arab Dictionary - Café", I1, Printing Companies for Distribution and Publishing, Lebanon.

6. Al-Shahri, Iman Ali Mahmoud, (2019), "A proposed unit in Bioplastics in light of the principles of green chemistry for the development of environmental gun skills and the trend towards preventive health among high school students", Journal of the Faculty of Education - Kafr Al-Sheikh University, Volume 19, Issue 4, p. (223-28.)0
7. Anastans PT and Warner Jc (2000): Green chemistry: Theory and practice, New York, Oxford University Press, U.S.A.
8. Bakar, Abdul Karim, (2000), "Renewing Awareness", i1, Dar al-Qalam, Damascus.
9. Bordens, K. S., & Abbott, B. B.(2014). Research design and methods: A process approach (Ninth ed .) McGraw-Hill.
10. Christensen, I.B., Johnson, R. B., & Turner, L. A. (2015). Research methods, design, and analysis (12th ed). Pearson Education Limited.
11. Habibi, L. **S**abbaghanb, M, & Mohammad, S. (2013). "A comparative study in Green Chemistry Education curriculum in America and China" .6th International Conference on University Learning and Teaching, Procardia –social and Behavioral Sciences, 288-292.
12. Hajjaj, Any Ahmed Abdel Fattah, (2020), developing the program of preparing chemistry teachers in faculties of education in light of the principles and applications of green chemistry, Doctoral Thesis, Faculty of Education - Department of Curriculum, Teaching Methods and Education Technology, Banha University, Cairo.
13. Horvath,I.T. & Anastas , P.T.(2007) . Innovations and Green chemistry . chemistry Review , 107 (6) , 2169 – 2173 .
14. Jindal, Jassim Mohammed, (2018), "Green Chemistry", I1, Wael Publishing and Distribution House, Amman.
15. Johnson, R. B., & Christensen, L (2019). Educational research: Quantitative, qualitative, and mixed approach. SAGE Publications, Incorporated.
16. Jouce, M., Howking, (1990): The Oxford large print Dictionary, Third Education, Oxford University Press, New York.
17. Karpudewan , M., Ismail , Z. & Mohamed , N. (2011) . Green chemistry Educating prospective science teachers in education for sustainable development at school of sciences, 7 (1), 42-50.
18. Manahan, S. (2006). green chemistry and the ten commandments of sustainability. 2nd ed. USA: they char research. Inc.
19. Mustafa, Mohamed Kamal (2016), "Culture of Progress - Problem and Solution", Friedrich Ebert Foundation, Egypt.
20. O'Brien Kp, Franjevic S and Jones J (2009): Green chemistry and sustainable Agriculture: The Role of Biopesticides, Advancing Green Chemistry, Pp. 1-55.
21. Paul T. Anastans, et al, (2009), Green chemistry education changing the course of chemistry, ACS symposium series; American chemical society Washington, DC.
22. Rywan, Suad Abbas. (2018) "The role of the teacher in promoting community responsibility" among middle school students, Institute of Beautiful Arts for Girls, Professor's Magazine, Issue 227, University of Baghdad, Baghdad.
23. Sanghi R. & Singh V. (2012). Green chemistry for environmental Remediation, scrivener publishing LLC. All rights reserved, Canada.
24. Susan D A and Maged S A, (2018), " The Effect of Cognitive Modeling Strategy in Chemistry achievement for students", Opcion, vol(34) No(17):pp498-520.
25. Susan. D. A (2020). " The Impact of fish bon strategy in the Achievement of chemistry and visual thinking among the seven grade students". Utopiay praxis latinoamericana, vol(25) No(1):pp 305-315.
26. Tundo P, Anastas P, Black D, Breen J, Collins T, Memoli S, Miyamoto J, Poliakoff M, and Tumas W (2002): Synthetic and processes in green chemistry, " Introductory overview," Pure Applied Chemistry, Vol . 72, No,7, Pp.1207-1228.