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Consciousness of Green Nanotechnology among Chemistry Scholars at the College of Education for Pure Sciences - Ibn Al-Haitham in Iraq

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Abstract

The study's objective is to find out the difference between the scholar of the research sample in awareness Green nanotechnology on the scaleas a whole and in each of its fields. The research depended of (136) specimen mem and women scholars of the fourth stage scholars / Department of Chemistry at the College of Education for Pure Sciences / Ibn Al-Haytham in Iraq for (2022-2023 AD) for the morning and evening studies, (65%) of the scientific community, It was picked at random with relation to the research instrument. it was a measure of awareness of green nanotechnology of (40) items, distributed in three areas (cognitive, skillful, emotional), and its validity and reliability were verified. Data analysis was completed for utilizing the statistical assay for society sciences (SPSS-22). The results showed Statistically, the research sample's pupils diverge from the hypothetical average on the scale's overall and across each of its areas in a way that is statistically significant. (cognitive, skillful, emotional). This means that there is a weakness in awareness of green nanotechnology. Green nanotechnology and green chemistry and integrating them into chemistry courses and emphasizing the applied side of student activities to enhance their awareness of green nanotechnology applications.

Keywords: Sustainable development, green nanotechnology, green chemistry, environmentally friendly applications, teacher preparation before service.

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Introduction

Contemporary trends in teacher preparation programs in colleges of education call for preparing the student with high academic preparation in his field of specialization, to reflect its impact on his teaching performance when teaching in secondary schools in the future, by paying attention to keeping up with scientific innovations, and emerging contemporary scientific concepts that achieve access to a society sustainable, but what is noticeable is: the lack of interest in sustainable development in university teaching, and the associated environmentally friendly applications of green chemistry concepts such as: the concept of green nanotechnology, Students do not understand nanotechnology and its green applications, and these concepts did not take place in the content of chemistry courses. An electronic survey of the opinions of a representative sample of (18) instructors from the Department of Chemistry at the College of Education for Pure Sciences - Ibn Al-Haytham for the academic year added weight to the research problem. (2021-2022). It included many questions to verify the interest of student preparation programs in sustainability and related concepts of green nanotechnology. Its results showed a lack of interest in this concept. The survey problem was cleared by reaction to the question: "What standard of realization of green nanotechnology between chemistry scholars at the College of Education for Pure Sciences - Ibn Al-Haytham in Iraq?"". The survey goal to identify the awareness of green nanotechnology between chemistry scholars by replying the following questions:

● Is there a statistically considerable variation at the significance standard (0.05) among all students of the survey sample in awareness? Green nanotechnology on the scale as a whole?

● Is there a statistically considerable variation at the significance standard (0.05) among the students of the research sample in awareness green nanotechnology On each area of the scale?

Research value

The most importance of university duties for the faculties of education is the elaboration and efficiency of lecturers, that reached by concentrate on what lead them able for interactive positively towards the challenges posed by the manufacturing revolution, nanotechnology, synthetic intelligence, and twenty-first century science. (Al-Hawry and Hamid, 2021 : 106), and (Troubridge et al., 2004), showed that “all changes that occur in science since Those who want to pursue a career in teaching will pursue education, so the teacher should understand the situation of science today, society also science education” (Trubridge et al., 2004: 59) .Therefore, it has become necessary to invest in education in achieving that

transformation by building capacities and improving skills for a workforce that is able to adapt to modern technical and technological transformations (Al-Malaki, 2021: 11)Accordingly, the objectives of teaching chemistry are to make the student able to benefit from scientific and chemical concepts and facts in various fields of life and to be able to solve the various problems that face him in scientific ways (Alewa and Muhammad, 2017: 501). So that Nanoparticles are groups of atoms, typically from (1 to 100) nanometers in size, that dependent on size, distribution, shape, and more than bigger particles of bulk material, display novel and enhanced features., (Suhail et al., 2022: 590).

The development of clean technologies represents the reduction of probably ecological and people health dangerous related with the production and utilize of nanotechnology manufactures and the promotion of alteration of existing manufactures with new nano-manufactures that are so eco-friendly along their life cycle is one of the definitions of Green nanotechnology, that is, the utilizing of nanotechnology to improve the eco-sustainability of processes which negatively affect the environment, as well as the use of nanotechnology results to enhance environmental friendliness. This contains producing nano-manufactures that are environmentally friendly and promote sustainable practices. (Sabri, 2023: 88), so green nanotechnology is a broad, exciting and growing technical field that combines chemistry and sustainability to protect human health and the environment. (Al-Abodi, 2023: 248)The term green nanotechnology refers to the promotion of environmental sustainability of processes that use nanotechnology in a safer way that does not produce external factors that negatively affect the environment, and additionally indicates of the utilizing of technological manufactures to develop clean technologies to decrease possibility ecology dangerous and people health correlated to the production beside nanotechnology utilize and promote the alteration of Current manufactures with newer and additional eco-friendly nano-products. (Mustafa et al., 2019: 430) Green nanotechnology applications are represented in five areas:

1st. The field of energy generation: Green nanotechnology applications have resulted in important roles in this field, represented by:

● Solar cells: contributed green nanotechnology by producing and developing solar cells with high efficiency, low cost and environmentally safe, by placing a thin film of silicon nanoparticles the size of one nanometer inside the solar cell, which increases its life and the efficiency of its production of electrical energy, as well as the use of some oxides in nanotubes or nanowires such as Titanium oxide

(TiO2), which has a high ability to absorb ultraviolet radiation and increase the spectral emission in the visible region, which leads to an increase in the efficiency of solar cells (Saleh, 2015: 158-160)

● Light bulbs: The use of cross wires made of semiconductors and nano-sizes ’ form the radiating structure of light as well as light-emitting diodes (LED) made the lamps to be highly efficient, less harmful and low cost (Al-Jubouri, 28: 2021)

● Environmentally friendly batteries: Carbon nanotubes have been used that increase the level of connectivity without adding heavy weight to the battery, as well as its flexibility. (Al-Bashir, 2012, 49)

2nd. The field of water purification: Some uses of nanotechnology can be mentioned in the design of nanofilms that purify water with high efficiency, especially with energy consumption in reverse osmosis technology. Reducing blo film fouling and the possibility of getting rid of organic pollutants in groundwater using palladium-doped iron particles. As for different metal oxides with nanostructures, they can eliminate biological toxins in water through photocatalysts and oxidation. It also contributes to the high-efficiency removal of arsenic from water by magnetite nanoparticles. And the speed and accuracy of detection of the presence of metals, biological toxins and organic compounds by sensors, which operate through a precise control system to detect and treat pollution. (Mohammed,2017: 21-22)

3rd. The field of atmospheric air purification: Nanotechnology has removed carbon dioxide from industrial laboratory fumes; Using carbon nanotube membranes and nanoparticle catalysts as a catalyst that converts gases emitted from cars and factories into harmless gases. (Al-Jubouri, 26: 2021) .In addition to getting rid of mercury fumes and getting rid of toxic nitrogen oxides and removing them from the air by using (cystia crystals) (Muhammad, 2017: 21-22)

4th .The field of agriculture: Nanotechnology has been able to produce nano-herbicides (Al-Bashir, 2012, 50-51), increase crop yields, pesticides usage decreasing, pesticides, also plant fertilizers by using nano-sensing and monitoring devices that are linked to the GPS system (Mervat and Ayman, 2017, 22-23).

5th. The field of food security: Nanotechnology applications are concerned with the manufacture of nano-capsules to enliven the food flavor, the alteration of meat cholesterol by smelting plant steroids, the abstraction of chemicals in food that led to illnesses, the manufactures of food preservation packages equipped with anti-fungal and antimicrobial nanoparticles, and the production of nano-chips as insulating materials that prevent food spoilage and oxygen absorption. In the production of attractive or smart foods that have the ability to sense a person’s sensitivity to a food component and the

production of food nano-bots that move in the blood circulation to clean fat deposits and kill pathogens. (Darbalah & Amani, 2016, 55-58)

Bounding of the terms

Green nanotechnology: It is the development of clean technologies to reduce the potential risks to ecology and people health correlating with the production, also utilize of nanotechnology manufactures, beside promoting the alteration of current manufactures with new nano-manufactures that are so eco-friendly." (Mustafa et al., 2019: 430)

Procedural Definition of Green Nanotechnology Awareness: A mental state formed by the scholres of the fourth stage, that leads them to realized and comprehend ideas, facts, ideas, and actions related to selecting environmental benefits and uses of nanotechnology in numerous industries, notably (energy field, water purification, air purification, agriculture, food security) , and the reduction of environmental risks, and it is measured by the degree obtained by the student on the measure of awareness of green nanotechnology prepared for this purpose.

Methodology

The research community and its sample

The descriptive correlational research method was adopted the survey community consists of all the fourth scholars of the Department in the college from the morning and evening studies, it reached (210) male and female students, given that the community is relatively small and for the purpose of determining the size of the survey sample, the Stephen Thompson equation was applied to extract the sample size using the program (Microsoft Excel), and thus the sample size reached (136) male and female students were selected in a simple random manner.

Search tool

After reviewing some scientific and educational books, a special scale for this research was prepared by following the following steps:

● Determine the goal of the scale: The objective of the scale is to measure the student's awareness of facts, concepts, ideas, applications and points of view, as well as behavior towards the use of nanotechnology and its applications to reduce environmental risks in order to achieve environmental preservation and safety.

● Determine the scope of the scale: (40) paragraphs were prepared consisting of three areas of awareness "cognitive, skillful, emotional"

by adopting five areas represented by (energy, water purification, air purification, agriculture, food security), as each area included positive and negative paragraphs, as follows:

- Cognitive domain: Student information on the concepts and applications of green nanotechnology, which includes (14) items, of which (9) are positive and (5) negative.

- Skill area: The student's behavior towards the concepts and applications of green nanotechnology and includes (13) items, including (11) positive and (2) negative.

- Affective domain: Student attitudes and attitudes towards the concepts and applications of green nanotechnology. It includes (13) items, of which (8) are positive and (5) negative.

The five-graded Likert method was adopted, which is (strongly agree, agree, not sure, disagree, strongly disagree), and the degrees of the positive items were determined by (5, 4, 3, 2, 1), respectively, while the negative items were determined with grades (1, 2, 3, 4, 5), respectively, its validity was verified by presenting it to the arbitrators specialized in teaching methods and chemistry sciences.

Statistical analysis of items of green nanotechnology awareness scale

The scale was applied to the statistical analysis samples (136) (27%) were selected from the higher grades and (27%) from the lower grades. The grades of the upper group ranged from (103-141), while the grades of the lower group ranged from (74-84). Then the following were extracted:

Internal Consistency Validity (Scale Construction Validity)

apply Pearson correlation coefficient It was found that the relationship between the score of each paragraph and the total score of the scale were all statistically significant, as the correlation coefficients ranged (0.534-0.804) when compared to the tabular value (0.161) at the significance level (05.0) with a degree of freedom (134). The correlation of the total score of the paragraph with the total score of the field to which it belongs was extracted (0.561-0.842), and when compared to the tabular value of the correlation coefficient of (0.161) at the level of significance (0.05), and the degree of freedom (134), it was found that all the paragraphs are statistically significant, as it was Checking the correlation of each domain with the total score of the scale The values are significant when compared to the tabular value of the correlation coefficient of (0.161), at the level of significance (0.05), and the degree of freedom (134), as the values for the domain (cognitive, skillful, emotional) reached (0.946, 0.944, 0.966), respectively, as it was extracted The matrix of internal correlations

between the scores of each field and the other fields shows that they are all statistically significant, as all the values of the correlation coefficients were greater than the tabular value (0.161) at the level of significance (0.05) and with a degree of freedom (134).

The discriminatory power of the items of the scale

Using the t-test for two independent samples, the significance of the difference between the averages of the two groups was calculated in the scores of each item of the scale. It was found that the values ranged (6.042 - 17.559). When compared with the tabular t-value (1.980) at the level of significance (0.05) and the degree of freedom (72), it was found that the t-values calculated for all paragraphs are greater than the tabular t-value, which is statistically significant, i.e. distinct.

Scale stability

Two methods were adopted, one of which is the (Cronbach's alpha) method. The stability of the scale as a whole was (0.742), while the stability coefficients of the field (cognitive, skill, emotional) were (0.725, 0.783, 0.709), respectively, and they are reliable reliability coefficients. (Half Split) .It finds the correlation coefficient (Pearson) between the two halves of the test items, and after correcting it with the Spearman-Brown formula, the stability of the scale as a whole was (0.845), while the stability coefficients of the field (cognitive, skillful, and emotional) were (0.825, 0.820, 0.858), respectively, which are stability coefficients good

Results and Discussion

The first question: Is there a statistically significant difference between the students of the research sample in awareness of green nanotechnology on the scale as a whole?

The t-test was adopted for one sample, and the arithmetic mean was (92.492) and the standard deviation was (9.170), while the hypothetical mean was (120), and the calculated t-value was ((-34.979), which is smaller than the tabular value of (1.960) at the level of significance (0.05). table (1).

Table 1. Results of the t-test of the Green Nanotechnology Awareness Scale.

significance level	T value		Hypothetical average	standard deviation	average Arithmetic	sample	variable
	Tabular	calculated					
0.05	1.960	-34.979	120	9.170	92.492	136	Awareness of green nanotechnology

From table (1), showed that the arithmetic mean of the research sample is less than the hypothetical mean, which indicates that there is a statistically significant difference among the research sample in the measure of awareness of green nanotechnology in favor of the hypothetical mean, meaning a weakness in the awareness of green nanotechnology on the overall scale.

The second question: Is there a statistically significant difference at the level (0.05) among the students of the research sample in awareness of green nanotechnology on each domain of the scale? The t-test was adopted for one sample for each domain of the scale, table (2).

Table 2. t-test of a scale Awareness of green nanotechnology.

significance level	T value		Hypothetical average	Standard deviation	Average Arithmetic	Number of paragraphs	Areas of awareness of green nanotechnology
	Tabular	calculated					
0.05	1.960	-20.148	42	9.170	32.905	14	Cognitive
0.05	1.960	-20.060	39	4.787	30.764	13	skillful
0.05	1.960	-29.521	39	4.020	28.823	13	sentimental

From table (2) showed that:

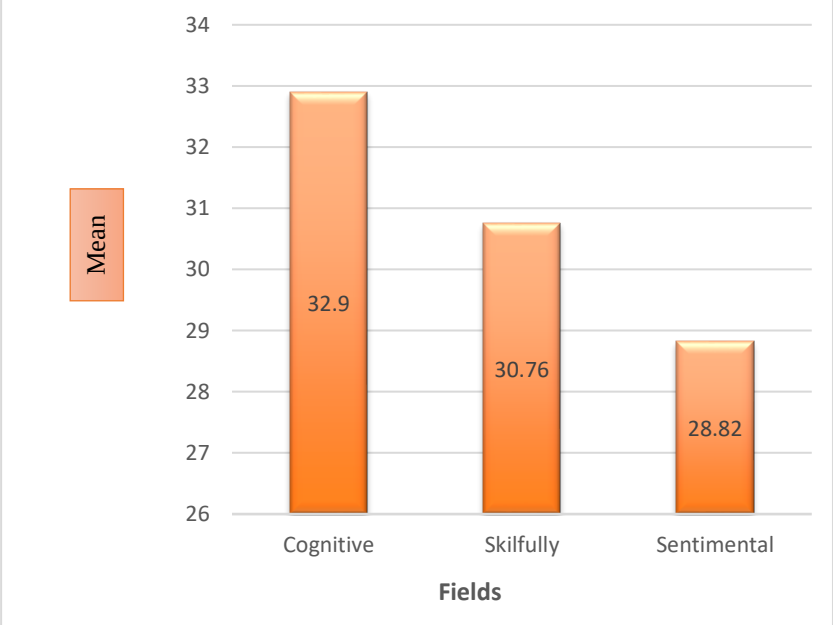
● Cognitive domain :The calculated t-value was (-20.148), which is less than the tabular value (1.960), at the level of (0.05) with a degree of freedom (134), and when comparing the arithmetic mean for the cognitive field of the students' scores of (32.905) with the hypothetical mean for the field of (42) degrees, it was found There is a statistically significant difference in favor of the hypothetical mean, that is, students have weakness in the cognitive field of awareness of green nanotechnology.

● Skill field :The calculated t-value was (-20.060), which is less than the tabular t-value (1.960), at the level of (0.05) with a degree of freedom (134), and when comparing the arithmetic mean for the skill domain of students' scores of (30.764) with the hypothetical mean for the domain of (39) degrees. It was found that there is a statistically significant difference in favor of the hypothetical mean, that is,

students have weakness in the skill domain of awareness of green nanotechnology.

● The emotional domain: The calculated t-value was (-29.521), which is less than the tabular t-value (1.960), at the level of (0.05) with a degree of freedom (134), and when comparing the arithmetic mean of the emotional domain of students' scores of (28.823) with the hypothetical mean of the domain of (39) degrees. It was found that there is a statistically significant difference in favor of the hypothetical average, that is, students have a weakness in the emotional domain of awareness of green nanotechnology, and Figure (1) shows the difference in the averages between the domains of Awareness of green nanotechnology.

Figure 1. The difference in the averages between domains Awareness of green nanotechnology



The statistical results showed that the students of the research sample have poor awareness of green nanotechnology in all its cognitive, skill and emotional fields, and that the students' information about the concepts and applications of green nanotechnology is very weak. These results are explained as follows:

- When referring to the measure of awareness of green nanotechnology, it was found that students lack awareness of energy-related information and trends. (90%) of the students did not realize that nanoparticles increase the energy of solar cells, as well as (86%) did not realize that they contribute to conserving energy and reducing

its consumption. And that (92%) of the students believed that the use of nano-applications in water purification reduces the efficiency of its purification, in addition to that most of the students did not see an effect of nano-applications in removing severe salinity and bacterial and chemical pollutants from the water, and (85%) of the students were in strong agreement That the use of nanocrystals in air purification causes an increase in the percentage of nitrogen oxides in the air, that is, they did not realize that nano-applications help in purifying the air from some toxic oxides and preserving the environment, and that (95%) of the students were not in agreement that nano applications can It helps to increase agricultural yields, in addition to their agreement that its use in agricultural fields causes environmental damage. Also, (83%) of the students strongly agreed that the use of nanoparticles in plastic packaging A food preservative that helps to oxidize and spoil those foods. (Diab and Rahmo, 2010) confirmed that manufacturing nanomaterials does not represent a step in the ladder of growth only, but rather is a use of knowledge in atomic science to produce new materials in a cheaper and cleaner way, with less capital and energy, and with more accuracy; Understanding the basis of the relationship between nanotechnology and society within the framework of social transformation requires identifying some initial concepts related to nanotechnology, as science, technology and societies are intrinsically linked, and this confirms that the application of scientific knowledge and the development associated with it is a major factor in the progress and prosperity of societies, and that Preserving, improving and protecting life using scientific knowledge and technical discoveries is at the heart of scientific and technical research, because science stems from the base of serving man. (Diab and Rahmo, 2010: 458-460) The researcher agrees with what (Hussein and Zaharia, 2007) indicated in “that in order for the student to be able to deal with the development in the knowledge and information revolution, the student’s participation in research and seminars related to society and the labor market should be activated (Hussein and Zahriya, 2007: 50).

- As for the student's behavior towards the concepts of green nanotechnology, which represents the skill field, it was weak and unfulfilled, due to the lack of interest in the chemistry department's courses in the concepts and applications of nanotechnology as well as green applications, and the lack of centers for developing and training students' knowledge and professional skills in the field of nanotechnology and its green applications and linking it to scientific developments Accelerated life, which resulted in students turning away from those new scientific paths in the field of nanotechnology and its green applications and their lack of interest in it, and (Al-Saadi, 2009) indicated that those interested and specialists in teaching

science should emphasize the importance of scientific innovations and include them in science curricula in the different stages of study and try to Developing scientific awareness among students of these innovations, to be a major goal of teaching science. (Al-Saadi, 2009: 10)

- But Students' attitudes and opinions on the concepts and applications of green nanotechnology, which represents the emotional field, was weak. This result was not compared with the results of previous studies because no previous studies were found (to the extent of the researcher's knowledge) that dealt with awareness of green nanotechnology.

Conclusions

In light of the research results, the following can be concluded the weak pre-service teacher preparation programs interest in green nanotechnology awareness. Weak interest in the information aspect of green nanotechnology among students of the research sample, also weak interest in students' attitudes and opinions on the concepts and applications of green nanotechnology.

Recommendations

Include concepts and applications of green nanotechnology in pre-service teacher preparation programs. Organizing workshops for faculty members and students to inform them of green nanotechnology applications. Establishing training centers affiliated to the Ministry of Higher Education and Scientific Research concerned with developing students' knowledge and professional skills in the field of green nanotechnology. Assign students to prepare scientific research in the fields of green nanotechnology, while carrying out applied aspects that simulate modern applications in the field of green nanotechnology. Benefiting from the measure of awareness of green nanotechnology to detect it among students. Establishing applied laboratories concerned with the practical aspects of green nanotechnology.

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