Awareness of Nanotechnology among students of the College of Education for Pure Sciences

Rana Riyad Ahmed and Prof. Dhamia Salem Daoud
ranariyadhahmed@gmail.com sdamiaa@yahoo.com
Modalities of pieces of training Chemistry Methods of teaching chemistry
Department of Chemistry, College of Education Pure Sciences / Ibn AL-Haitham, University of Baghdad, Baghdad, Iraq

Article Received: 20 May, 2021; Article Revised: 26 May 2021; Article Accepted: 1 June 2021

Abstract

Extracted

The current search aims to identify:

1-Awareness of nanotechnology among students of the Faculty of Education for Pure Sciences - Ibn al-Haytham

2-Statistically significant differences in awareness of nanotechnology depending on the sex variable (male, female)

To achieve the research objectives, the researcher adopted the descriptive research curriculum and the research community was identified and selected: students of the fourth stage chemistry department/ morning study in the Faculty of Education for Pure Sciences - Ibn al-Haytham, for the academic year (2020-2021) m, and the research sample consisted of (100) students by (47) students and (53) students. The nanotechnology awareness scale was built from 30 paragraphs. After verifying the geometry properties, the scale was applied to the research sample and the results showed that students of the Faculty of Education for Pure Sciences - Ibn al-Haytham - had an awareness of nanotechnology. The effect of the sex change in the awareness of nanotechnology is in favor of males. In the light of these findings, the researcher developed several recommendations and proposals.

Problem statement

In the current era of tremendous development in various areas of life, students must be familiar with contemporary scientific developments and techniques to be more aware of this field and able to meet the challenges that meet them.

Students must be aware of biotechnology innovations, particularly nanotechnology and its requirements, a technique that has emerged in the past few years and has become the focus of great attention. (Nema and Kazem, 2018) Here confirms the vital role of the educational process at the university level to develop that knowledge and skills, we find there is an urgent need to follow the awareness of the university student with nanotechnology in various fields to get a conscious and educated generation that plays its role to contribute to the protection of the environment

Nanotechnology has advanced in strides and increased its importance through its association with the lives of individuals and society, and when conducting a survey of the opinions of a sample of (20) students of the Faculty of Education for Pure Sciences - Ibn al-Haytham on the subject of nanotechnology, the researcher found that the percentage (80%) From the sample they do not have awareness of nanotechnology, and here the researcher may ask the following question:

How aware of nanotechnology among students in the Chemistry Department of the Faculty of Education for Pure Sciences - Ibn al-Haytham?

The Importance of research:

Nanotechnology is modern science that has begun to enter all walks of life from scientific and medical research and termination to heavy industries and military equipment, where nanotechnology applications are currently being used in all fields including electronic industries, information technology, medical and health field, and material development, and scientists stressed that nanotechnology will create a new industrial revolution shortly leading to radical transformations in the economy and technology. (Salama, 2009, 75.(

Nanotechnology is one of the most important technologies of our time and has become one of the most important fields in the field of science because of its profound impact in various respects including environmental sustainability to be based on the activation of nanotechnology in our scientific and practical public life and the preservation of the environment. (Boras, 2018, 13)

The concept of nanotechnology has become linked to the development of the educational system as it is a contemporary type of technology based on the integration of many disciplines that must be integrated into the educational system and take advantage of its applications. (Al-Qahtani, 2020, 175)

Nanotechnology is a broad applied area as it, directly and indirectly, enters all human needs and scientific and environmental developments. (Ayad, 2017, 177).

It is therefore essential that the student be aware of the field of technology to keep up with the developments as it has become a requirement to meet the challenges of the times (Darwish and Abu Omara, 201,2018)(

Yawson,2012 argues that nano consciences need to be integrated into curricula for students to become more aware and understanding of nanotechnology, i.e. there is an urgent need to be aware of developments and developments related to nanotechnology and its effects on environmental sustainability, so-called nanoring or nano-enlightenment (Yawson,2012,297).

She stated (Al-Otaibi, 2021, 44) the need to introduce nanotechnology in the field of education due to its importance to students in general and higher education students in particular, to contribute to the creation of students capable of making smart and independent decisions on social issues related to nanotechnology and employing them optimally based on the conceptual frameworks they have learned at this stage of education.

The importance can never be highlighted in its theoretical and applied aspect.

1-Highlights awareness and its components (cognitive, skill, and emotional nanotechnology)

2-Highlights the concept of nanotechnology and its areas of application (agricultural, industrial, medical)

3- To determine the awareness of students in nanotechnology included in the study scale can benefit the authors of the university curriculum by integrating the concepts of nanotechnology with courses for the dedicated course.

The aims of the study :

The current research aims to find out what comes next-

1-Awareness of nanotechnology among students of the Faculty of Education for Pure Sciences - Ibn al-Haytham.

2-Statistically significant differences in awareness of nanotechnology according to sex changer (male, female)

To achieve the objectives of the current research, the following questions have been formulated:

1-Do students of the Faculty of Education for Pure Sciences - Ibn al-Haytham have an awareness of nanotechnology?

2. Is there an impact of gender change (male, female) on nanotechnology awareness among students of the Faculty of Education for Pure Sciences - Ibn al-Haytham?

Research limitations :

The current research is determined by the students of the Faculty of Education for Pure Sciences Ibn al-Haytham/ Department of Chemistry / Fourth Stage, within the academic year 2020/2021

Determination of Term:

First: nanotechnology,

Abu Zeid defines it (2011) as: "Dealing with the material on a very small scale of (1-100) nm and mainly concerned with controlling and controlling the material at its atomic and molecular level" (Abu Zeid, 2011, 34)

Saleh defines it (Saleh, 2015) as "a technique that produces combinations of dimensions at the nano-level ranging from (1-100 nm) " (Saleh, 2015, 19)

Second: Awareness of nanotechnology:

Known (Ayad, 2017) means "the student's degree of understanding, knowledge, experience, activities, and motivation related to nanotechnology that may affect the direction of his behavior towards attention in this field" (Ayad, 2017, 189)

Theoretical Definition: The Researcher Adopts a Definition (Ayad, 2017)

The researcher defines it procedurally: awareness of nanotechnology: "The degree to which the student gets by applying the nanotechnology awareness scale prepared by the researcher for this purpose".

Theoretical background

First: awareness

Referring to the tongue of the Arabs and the linguistic dictionaries, we find that the word awareness came in the sense of understanding and preservation, so it is said to memorize the heart and the thing conscious because it is aware of any understanding and memorization (Ibn Ma'erq, 1979, 4876)

Awareness is meant as knowledge, perception, understanding, appreciation, and sense of an area, which affects the orientation of the individual's behavior towards this area (Qandil, 2001, 36), and scientists have made great efforts about the concept of awareness as it interferes with many processes such as sense, perception, and memory, considering it the basic ground behind all components of behavior, and there is awareness to varying degrees in the sense that there is a low or high degree behind the exciting situation, there is self-awareness, scientific awareness, moral awareness, environmental awareness, Religious awareness, political awareness, etc. (Bakar, 2000, 9).

Second: Nanotechnology

Nanoscience is modern science that looks at the design of micro-devices based on construction modification.

molecular or atomic material to build new compositions. As Alexandrian, 2010, defined it as an open prefix of ancient Greek and meaning dwarf, the Nanos word is derived from the Greek word Dwarf and means a fraction of a billion meters, so it's very precise. (Alexandrian, 2010, 17).

Nanotechnology is micromaterials or micro-technology that deals with nanotechnology, which in turn studies the basic principles of molecules and compounds measuring no more than 100 nm and therefore the possibility of producing new devices that are of great benefit in our working lives. (Yasiri, 2013, 18)

We do not mean nanometer by itself, but rather technology that deals with objects on this scale to produce highly efficient tools and devices with nanoparticles such as non-scratchable screens and rechargeable batteries. (Hijazi, 2012, 63)

The importance of nanotechnology:

Technology has become the most important and exciting field in physics, biology, chemistry, engineering, and many other fields, where it gave great hope for scientific experiments shortly as it will change the technical destination of many applications, and enable us to address the environmental risks diagnosed to address the effects

of pollution such as cleaning groundwater and reducing the number of harmful emissions and processing. (Sergeant, 2014, 116).

Salama (2009) has identified several factors that it believes are the source of interest in nanotechnology at the moment and the next phase, these factors were:

-It's an inexpensive and modern technology compared to the technologies currently in use, and its economic returns are very high.

It integrates science and technology to move towards scientific applications, starting with the components of the basic material (atoms and molecules), making its impact significant and wide to all areas of science. (Salama, 2009, 37).

Saleh (2015) sees nanotechnology benefits including:

It improves manufacturing methods, water technology systems, and energy grids

-Improves large-scale food production methods

Promotes physical health and nanomedicine (Saleh, 2015,39)-

Properties of nanomaterials:

The properties of nanomaterials change when they are nanoscale, and some of these properties have been identified as follows:

-Magnetic properties: The strength of magnets depends entirely on the measure of the dimensions of the material granules manufactured from them. The smaller the granules, the stronger the magnets and the stronger they are.

B- Physical properties: such as the strength and rigidity of the material, it increases at the nanoscale level, for example, the strength and rigidity factors of carbon nanotubes, where it sometimes reaches (1210) Newton/M2 equivalent to five times the material of steel.

C- Chemical properties: As a result of the presence of large numbers of nanomaterial atoms on their outer surfaces, they act as catalysts that interact strongly with toxic gases for their filtration, which has played an important role in reducing the environmental pollution.

E- Optical properties: Nanoparticles can change color, the golden color of gold changes to orange when the size of particles is less than (100) nm, as well as the gold solution becomes green when its particles are less than (50) nm. (Al-Hasani, 2009, 50-52**)**

Nanotechnology in education

Xie&Pallan, 2012,1807, asserts that the introduction of nanotechnology into education is essential and important in the 21st century, representing the area in which it can connect and integrate the basic branches of science, Shelby noted, 2012, 50) to the importance of learning and teaching nanotechnology in general and university education to help students become familiar with nanotechnology and the basic requirements of life in light of the choices it offers and the risks it causes, and based on the conceptual frameworks they learned during the study stages This is why the science curriculum is supposed to bring about changes in concepts and skills associated with nanotechnology and contribute to the development of scientific culture among students, as well as in all aspects of the educational process to meet all the challenges associated with technical applications to achieve educational objectives. (Al-Attiyah, 2016, 135).

Nanotechnology applications

Nanotechnology is involved in many fields such as chemistry, physics, biology, medicine, engineering, agriculture, electronics, and more. Nanotechnology has contributed significantly to the fields of knowledge **and its many applications, including:**

The field of water treatment and purification 1-

Water pollution is one of the most serious health problems in the world, affecting its living quarters such as fish and other aquatic organisms and not suitable for human consumption as drinking water. Nanotechnology is used to reduce water pollution by helping to produce membranes with very small holes (1 nm) that can hold organic matter such as pesticide particles and allow only water molecules to pass through it, and practical and field experiments have confirmed a reduction in the cost of desalination by approximately 75% compared to the high-cost reverse osmosis technology used during this period. Nanofiltration (nanofiltrations) has been used as a water purification technique. (Alexandrian, 2010, 239).

The field of purification of whims 2-

In this regard, carbon tube membranes have been used to remove carbon dioxide from factory chimney fumes, acting as sieves to separate large quantities of methane and carbon dioxide from other gases. Nanoparticles stimulating materials are also used as an adjunct to convert fumes from cars and factories into harmless gases.

Agriculture: 3-

The use of small proportions of nanoweed pesticides with a diameter of less than (100 nm) can easily blend with the soil and attack the cover of weed seeds and prevent them from germination and this method is less expensive than known control methods such as tillage and Yiddish resistance to grass and help to increase the growth of crops and improve soil, which reflects positively on crop quality. (Al-Bashir, 2012, 49-51)

The field of medical sciences:4-

Nanotechnology seeks to change the way many diseases are diagnosed and treated to contribute to early detection and human health, including:

- **Therapeutic drugs and drugs**

Scientists in the medical world have come up with a new term, "xenobiotics", which is used as a natural antibiotic that helps fight deadly antibiotic-resistant bacteria where xenobiotics pierce the walls of deadly antibiotic-resistant infectious bacteria and kill them. (Abdullah, 2012, 64)

Nanotechnology diagnosis

The use of nanotechnology in tests and tests to detect the presence of tested materials has become faster, more flexible, and more accurate when combining magnetic nanoparticles with appropriate antibodies is used as a sign of limited molecules or microbes. (Saleh, 2015, 138)

Energy:

Nanotechnology has been able to use the most optimal in storing, producing, and converting energy, the most important of which are:

Solar cells-

Nanotechnology has been used to create efficient and environmentally friendly solar cells, where a thin layer (membrane) of 1 nm (1 billion meters) of nanoscale silicon minutes is placed inside the solar cell, increasing the production of its electrical energy and prolonging cell life. (Sid, 2012, 66).

Light bulbs:

Light bulb and fluorescent have been common since the last century, whose work is characterized by heating the wire to a high temperature and radiating light and heat, as nanotechnology enters the world of light release using nanoscale wires that form the radioactive structure of light, as well as the light-emitting Diodes, LED, which is exactly the opposite of the PV cell. (Ratner, 2010, 147)

Environmentally friendly batteries:-

Nanotechnology has been used to make high-energy and rechargeable batteries using nano-carbon tubes that are lightweight, flexible enough, and useful to get rid of the huge number of batteries consumed. (Al-Bashir, 2012, 49)

Industry

Flat screens-

It is one of the latest display technologies for computers, mobile phones, and digital cameras made of nanostructure polymer membranes called OLED, one of its advantages: screens are smaller, lighter, and stronger than LCD screens as well as less energy-consuming. (Mongillo,2007, 131-132).

Nanotechnology coating or packaging:-

It is an important application of nanotechnology where nanoplates are working to form a packaging layer that protects electronic device screens from scratches and friction and the packaging layer is solid materials and means of very small particles characterized by extreme flexibility, ease of adhesion, and resistance to corrosion and growth of microbes. (Salama, 2009, 88(

Consumer products 7-

Nanotechnology is involved in the consumption of various goods and products aimed at improving its quality and properties, such as:

-Tissues and clothing:

Tio2 nanoparticles are used to manufacture self-cleaning clothing without the need for a washing machine, as they only need sunlight that interacts with these molecules to break organic compounds such as food, oils, odors, pollutants, and harmful micro-organisms such as viruses and bacteria and convert them into carbon dioxide and water. (Abdullah, 2017, 70)

Household appliances-

One of the most popular applications of nanotechnology in the field of household appliances is easy surfaces to clean or self-cleaning, as nanoscience particles improve the smoothness of cooking utensils and increase their resistance to heat. (Abdullah, 2012, 147)

Cosmetics and sun protection-

Currently used in some cosmetics such as sunscreens nanoscale molecules such as titanium dioxide, act as effective UV filters and protect skin from them, and do not cause health damage to the skin (Fytianos&Rahdar,202 0.3).

Nano food

The introduction of nanomaterials such as nanoparticles for free metal elements of iron, zinc, and omega3 has raised the quality and value of food together. In China, Qinhuangdao Taiji Ring has used nanotechnology to process tea molecules below 100 number, called nano-tea, rich in selenium, which reduces cholesterol and blood fat. (Momin,Jchitra,2012,12).

Research methodology and procedures

The researcher adopted the descriptive approach in this research to suit the problem of his current research and its purpose, focusing on describing the phenomenon, identifying the relationships between its elements, or between it and another phenomenon

First: The research community: the current research community is determined by the students of the fourth stage department of chemistry/morning study in the Faculty of Education for Pure Sciences - Ibn al-Haytham,

There are 230 students for morning study with 109 students and 121 female students for the academic year (2020-2021).

Second: The research sample: For the sample to be representative of its indigenous community, the researcher took a sample of the fourth stage chemistry department, which is 100 students from the research community by 47 students, and (53) students .

Third: Search tool:

Nanotechnology Awareness Scale

After reviewing the literature, previous studies, and the opinions of experienced professors specializing in the teaching methods of chemistry, the researcher identified three areas: the cognitive field, the skill field, the emotional field, and formulated for each field (10) paragraphs, and the researcher identified for each paragraph five alternatives: Strongly approved, OK, neutral, non-OK, strongly disagreed) and the weights of alternatives to positive paragraphs were (5, 4, 3, 2, 1)

The measure was applied to a sample of students (100) students, the members of the upper and lower group reached 27% by 27%, confirmed its virtual sincerity by presenting it to a group of experts and specialists, and confirmed the internal consistency of the scale by the adoption:

1-The paragraph is linked to the overall degree of the domain using the Pearson equation, although the scheduling value is equal to (0.195) at the level (0.05) and to a degree of freedom. The result was that all paragraphs were indicative because the calculated value was greater than the scheduling value. Table (1) shows this.

ıe value of the ragraphs' rrelation efficient in the ;al scoreدرجة	ragraph quence	ragraph correlation efficient value in al degree	ragraph quence	ragraph correlation efficient value in total degree	ragraph quence
27		22		19	
28		29		18	
33		21		26	
21		32		29	
32		29	th	20	
26		26		23	
29		19		22	
35		18		24	
18		17		25	
26		23		33	

Table (1) The correlation coefficient between the score of each paragraph and the total score of the scale

2-Paragraph degree relationship to field degree to which you belong to calculate the value of the correlation coefficient between the degree of All a paragraph Of the paragraphs of the scale and the degree of the field to which they belong The Pearson correlation coefficient was applied to find the values of the correlation coefficient, and the table)2) shows that.

Table (2) Factor Relevancy of the paragraph's degree to the field to which it belongs

e values of the correlation efficient of the paragraphs with e total score of the field	ragraph numbers	mber of ragraphs	e field	ld number
25				
31				
19				
24				
33			gnitive	
30				
21				
36				
33				
31				
25				
24				
22				
21				
34	th			
37			ills	
37				
29				
31				
35				
32				
19				
21				
18				
23			ntimental	
22				
34				
39				
32				
26				

3- The relationship of the degree of the field to the total degree of the scale. To calculate the value of the correlation coefficient between the degree of the domain and the total score of the scale, the Pearson correlation coefficient was applied to find the correlation values, and table (3) shows that.

Table (3) Correlation coefficients between The subdomain of the main component to which it belongs and the overall score of the scale

otal marks anotechnology Awareness Scale	**ompassionate**	**ills**	**ognitive**	**elds**
400	387	399		ognitive
305	321		399	kills
376		321	387	ompassionate
	376	305	400	otal marks anotechnology Awareness cale

B. Scale stability: Stability means the accuracy or consistency of the scale. The stability has been calculated using Cronbach's alpha equation The stability was extracted in this way from the scores of the basic sample forms and using the Cronbach equation, the alpha coefficient was (0,85), which is a good stability coefficient.

Presentation, interpretation, and discussion of the results:

the first goal: Do students of the College of Education for Pure Sciences have awareness of nanotechnology?

To learn about technology awareness among students of the College of Education for Pure Sciences, Use the TESTA one-sample t-test to calculate the significance of the difference between the two averages, and Table (4) illustrates this.

Table (4) ThedieArithmetic mean, standard deviation, and t-value Nanotechnology awareness scale

dication ,05)	value		pothetical ean	ndard viation	erage ithmetic	e sample	ariable
	abular	alculated					
nction	98	,958		404	767	0	wareness of notechnology

show from table(5) The arithmetic mean of the scores for this sample reached

(3,767) with a standard deviation of (0.404), and when knowing the significance of the difference between the arithmetic mean and the hypothetical average, which amounted to (3), it was found that the difference was statistically significant at the level of significance (0.05), as the T-value reached calculated (18,958), which is greater than the T-table value of (1,98) with a degree of freedom (99), which means that the students have awareness of nanotechnology, The researcher explains this result to Students' interest in scientific innovations and developments in nanoscience, in addition to the fact that nanotechnology was taught to them in the third stage as an additional scientific subject (special lesson), which contributed to increasing their awareness of nanotechnology and its various applications.

The second objective: Is there an effect of the gender variable (males, females) on the awareness of nanotechnology among students of the College of Education for Pure Sciences - Ibn Al-Haytham?

To confirm the differences in Awareness of nanotechnology Depending on the variable for sex used researchers' post-test of two independent samples are not equal results were as shown in table (5).

Table (5) Arithmetic mean and standard deviation of awareness of nanotechnology according to the gender variable (male, female)

dication ,05)	value	eedom	ndard viation	erage ithmetic	e number	ex

	ıbular	ılculated					
nction atistically in vor of males	98	100		.195	5,660		ale
				.684	0,642		male

The results showed that the arithmetic averages of the gender variable (males, females) are (115,660), (110,642) respectively, and the test results showed that the calculated t-value amounted to (2,100), which is greater than the tabular t-value of (1.98) at the degree of freedom (98) and the level of significance (0.05), and thus it can be said that there are statistically significant differences in the nanotechnology awareness variable according to the gender variable and in favor of the group with the largest arithmetic mean, namely the males.
The researcher explains this result that there is an effect of the gender variable (males, females) in the awareness of nanotechnology in favor of the male category, and this is due to the increase in their scientific knowledge of nanotechnology by linking them to information within the scientific material that they were studied for during the third stage with the practical aspect of nanotechnology applications In the fields: (economic, social, environmental).

Second: Conclusions: reached to me Several conclusions are as follows:
1.Students of the College of Education for Pure Sciences possessing an awareness of nanotechnology, as a result of their study of nanotechnology in the third stage of their university studies.
2. There is an effect of the gender variable on the awareness of nanotechnology for students of the College of Education for Pure Sciences in favor of male students.

Third: Recommendations: Based on the results of the research, TResearcher guardian as follows:
1.Encouraging and motivating students to prepare for research and participate in scientific activities in the field of nanotechnology 2. Developing the educational institution in the field of nanotechnology by providing the techniques to establish a laboratory dealing with nanotechnology and its applications.
3. Include curricula for secondary levels and academic courses in the university stage to keep pace with the global development in nanotechnology as it is the technology of the age

Fourth: Suggestions: continuation for this study The researcher suggested the following:
1. An analytical study for developing curricula in light of the concepts of nanotechnology and its applications.
2.The effectiveness of using a proposed program to train students of the College of Education for Pure Sciences in the light of the concepts of nanotechnology and its applications in the fields of the environment.
3.Conduct a study similar to the current study on Other scientific departments For academic stages.

Sources.

1. -Abdul Latif, Abeer bint Muhammad(2011): The effectiveness of a proposed training program in developing awareness of some concepts of nanotechnology "nanotechnology" among science teachers in the Al-Jouf region. Unpublished master's thesis. Princess Nora University, Riyadh.
2. -Abdullah, Abdullah Ahmed(2017): Applications of nanotechnology. The impact of nanotechnology applications on the materials used in the external facades of buildings. Master Thesis. College of Engineering. Cairo University.
3. -Abdullah, Ali Muhammed(2012): The**Nanotechnology between hope and fear**, Al Dar Al Arabiya Book Library, Cairo.
4. aBen Manzur(1979): Arabes Tong, Sixth volume, House of Knowledge, Cairo‹-
5. -Abu Zeid, Hana Mahdi(2011): Nanotechnology, i 1, Horus International Foundation for Publishing and Distribution, Alexandria.
6. -Al-Bashir Muhammad, Muhammad Hashem (2012): The dangers of nanotechnology, Dar Al-Hamid for Publishing and Distribution, Alexandria.
7. Alexandrian, Mohammed(2010): Nanotechnology, for a better tomorrow, a world of knowledge, Kuwait.
8. -Al-Hussaini, Najm Mister (2009): The Story of Nanotechnology, 1st Edition, Dar: house Book world for printing, publishing, and distribution, Riyadh.

9. Al-Otaibi, Suzan bint Ghazai Ghazi (2021 .)**)**: Awareness of Nanotechnology among Female Students of the College of Science at the University of Jeddah in the Kingdom of Saudi Arabia, The Arab Journal of Scientific Publishing, No. 28, pp. 35-66.
10. -Al-Qahtani, Othman bin Ali)2019 :(A proposed conception to include the concepts of nanotechnology in the developed mathematics curricula in general education stages. Journal of the Islamic University of Educational and Psychological Studies, Volume 28, Issue 2.
11. -Al-Qurra Lucy, Hassan Ahmed Suhail and Jabbar Wadi Bahid Al-Aqili(2012): The psychology of self-awareness and social persuasion, 1st ed, Al Yamamah Library, Baghdad.
12. -Ayyad, Fouad Ismail(2017): degree awareness of nanotechnology among technology teachers and the impact of a proposed unit on developing cognitive achievement and learning satisfaction among Al-Aqsa University students in Gaza. Al-Aqsa University Magazine, folder21, No. 1, pp. 175-217.-
13. Bakkar, Abdul Karim (2000): Renewing Awareness, 1st Edition, Dar Al-Qalam, Damascus.
14. -Boras, Fayza, and Haroun Al-Ashi (2018 .)): The importance of applying nanotechnology in renewable energies to achieve sustainable development, Journal of Human Sciences of Oum El Bouaghi University, Vol. 5, No. 2, pp. 555-567.
15. Damas, Mustafa Nimr(2015): no talking Strategies in the teaching of general sciences, 1st floor Dar Ghaida for Publishing and Distribution, Oman.
16. DrRWish, Atta Hassan and Abu Umrah, Hala Hamid(2018): The level of knowledge of nanotechnology applications among students of faculties of education majoring in science in Gaza universities and their attitudes towards it, Journal of the Islamic University of Educational and Psychological Studies, Volume 26, Issue 1, pp. 200-229.
17. -Fytianos, Georges&Abbas Rahdar, and George Z.Kyzas, (2020): "Nanomaterials in cosmetics: Recent updates", Journal nanomaterials, v(10), issue(5).
18. Hijazi, Ahmed (2010): Nanotechnology, the new technological revolution, Kunooz Al-Maarifa House for Publishing and Distribution, Amman.
19. -Jafarali Momin, Jchitra, Jashbhai Prajati, (2012): “Potential of Nanotechnology in function foods” Emirates Journal of Food and Agriculture, V(5), Issue(1), P: 10-19.
20. Kandil, Ahmed (2006): Training with modern technology, World of Books, Cairo.
21. -Labad, Amal Ibrahim (2013): Enrichment of some science curriculum topics with nanotechnology applications and its impact on the level of scientific culture for eleventh-grade students in Gaza. Unpublished Master's Thesis, Al-Azhar University, Gaza.
22. Mongillo, John F, (2007), "Nanotechnology 101", greenwood press, London.-
23. Mosul University websiteUniversity of Al Mosul (uomosul.edu.iq)
24. -Name, Wasan Qassem, and Esraa Naji Kazem (2018): Acquisition of nanotechnology concepts among chemistry students at the College of Education for Pure Sciences/Ibn Al-Haytham and its relationship to their technological awareness. Journal of the Educational Path for Social Sciences, Volume 56, Issue 14, pp. 362-389.
25. -Ratner, Mark and Daniel Ratner(2011): Nanotechnology is a simplified introduction to the next great idea, Translation. Hatem Al-Najdi, 1st Edition, The Arab Organization for Translation, Beirut.
26. -safety, attributes(2009):Nanotechnology: A Small World and a Big Future Introduction to Nanotechnology, Arab Science House, Lebanon.
27. -Salah, Mahmoud Mohamed Slim (2015): Nanotechnology and a new scientific era, King Fahd National Library, Riyadh.
28. Sergeant, Ted(2008): The dance of molecules: How nanotechnology is changing our lives, translation.
29. -Shelby, Nawal Mohamed(2012): A proposed unit for developing nanotechnology concepts and environmental thinking among secondary school students. The Twenty-Second Scientific Conference of the Egyptian Society for Curricula and Teaching Methods. Curriculum in the Knowledge Society, Volume 1, p. 7-61
30. Syed, Rehab Fayez Ahmed(2012): Nanotechnology in the field of information and communication. Opportunities and challenges, I know the magazine, No. 11, pp. 113-165.

31. -the gifts, Alia Muhammad (2016): The level of understanding female science teachers in the fields of nanotechnology and their attitudes towards these technical applications, Journal of Educational Sciences, Vol 24, the number 1, Pp. 127-166, Egypt.
32. -Xie, C & Pallan, A. (2012); Antimicrobial applications of electroactive PVK-SWNT nanocomposites, Environmental science, and Technology 46(3)), 1804-1810.
33. Yawson, R. (2012): An epistemological framework work for nanoscience and nanotechnology literacy, International Journal of technology and design education, 22(3), 297-310.