Knowledge and Perception of Nanotechnology Among Students of Agricultural Faculties' in Jordan

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Abstract

This study investigated Knowledge and Perception of Nanotechnology among Students of Agricultural Faculties' in Jordan. The research was based on distributing a questionnaire. This study collected data from 485 respondents, of which 410 were analyzed. The results revealed that a very significant finding that the majority of the investigated students (45%) have already heard the word 'nanotechnology', though (72%) of those (45%) do not know about nanotechnology very well. The results of the present study indicated that students have basic or no enough knowledge about nanotechnology. The results also showed that students were with a very superficial knowledge of Nanotechnology. Moreover, none of the examined variables has no significant effect on the perception toward nanotechnology. Even though it is expected that students with higher years of study could show more expertise and acquire more developed topics such as the Nanotechnology concept, the students showed similar knowledge of Nanotechnology regardless of their year in study. The study recommends that the Jordanian educational policymakers in higher education should consider the inclusion of the Nanotechnology concept in the curricula of the different academic courses.

Keywords: nanotechnology, perception, knowledge, Jordan

1. Introduction

Nanotechnology is becoming more and more popular every day. It is emerging as a leading field in the technological revolution in the new millennium. Nanotechnology research is likely to change the traditional practices of agricultural products. This issue creates a challenge for the academic community to educate agricultural students with the knowledge, perception, and skills to interact and provide leadership in the emerging world of nanotechnology (Ozel, 2008). In Nanotechnology, we are concerned with natural and synthetic materials (Kulkarni, 2015). However, there are concerns about the lack of an internationally accepted legal framework to regulate and govern the possible consequences of the application of nanoparticles. In governing the application of nanoparticle regulators; academics and researchers are divided into platforms to decide whether new legislation is required with minor or major modifications or whether the existing legislation is sufficient. Whatever the situation in this regard, the public understanding and acceptance must be considered as one of the primary steps concerning the introduction of nanotechnology as a new and emerging technology in the market, and to regulate it to avoid a situation such as genetically modified foods and nuclear energy that the international community witnessed in recent years (Karim et al., 2019).

Recently, nanotechnology has emerged as a multidisciplinary field, in which gaining a fundamental understanding of the electrical, optical, magnetic, and mechanical properties of nanostructures promise to deliver the next generation of functional materials with wide-ranging applications. Nanostructures can also provide solutions to technological and environmental challenges in the areas of catalysis, medicine, solar energy conversion, and water treatment (Nasrollahzadeh et al., 2019). However, Nanotechnology enables manufacturers to convert knowledge to produce lighter, stronger, powerful, more durable and commercially viable products. So, more countries, irrespective of size economy, are already in the global race to utilize this nanotechnology for their future development as well as to become the market leader in different sectors (Karim et al., 2017; INIC, 2014). As a result of the importance of this technology, countries in different parts of the world took an interest in nanotechnology and sought to introduce nanotechnology in the fields of teaching and education. Nanotechnology tops the list of scientific and research interests in most of the world, as (52) countries during the

past ten years established programs, research units, academic and research institutes, centers, and laboratories. The steady growth of nanotechnology represents a challenge for the scientific community interested in universities and technical colleges to prepare the workforce to provide future job opportunities (Alhusani, 2019). Many developed countries have include nanotechnology applications in their school curriculum.

On the scope of Arab Countries, some research has emerged that discusses the topic of nanotechnology from an educational or evaluation perspective. Especially in the field of developing science education and upgrading the curricula to keep pace with modern scientific developments and exploring the extent of the ability of our current curricula to absorb the upcoming scientific change (Al-Rifai, 2019). Many studies were documented about nanotechnology-related issues such as awareness, perception, understanding, knowledge, benefits, and risks (Karim et al., 2017). Many studies investigated students perception toward nanotechnology revealed that even though there are some general concerns as to the risk, safety and Halal application of the nanotechnology, a large number of the investigated students, irrespective of gender, nationality, religion, and level of study are aware of the term 'nanotechnology'. They are able to identify the benefits of nanotechnologies to them as direct consumers. The majority of them are also aware of the presence of several Nano-enhanced consumer products including cosmetics, automobiles, and computer accessories in the local market. The results also confirmed that more than 80% of the respondents favor the application and introduction of this technology to other sectors. Ahmed (2015) in a study aimed at revealing the effectiveness of applications of nanotechnology in the environment among students of the Faculty of Education at Ain Shams University focused on the educational environment within universities. The results of the study showed that the proposed program was with a positive impact on the student's awareness of nanotechnology applications.

According to Taha (2014), there was a decrease in the level of public awareness of nanotechnology concepts and their various applications among students and teachers in the Agricultural Sciences department. A study conducted by Anderson (2013) revealed that sharing different definitions of individuals enabled them to come up with different levels of support for nanotechnology. The participants were given one of three definitions of nanotechnology i.e. the first definition focused on nanotechnology's novel applications, the second one considered its risks and benefits, and the last one included both applications and risks and benefits. A study conducted by Elmarzugi et al. (2014) about the "Awareness of Libyan Students and Academic Staff Members of Nanotechnology", based on a survey collected randomly from many campuses of Tripoli University (Alfateh), and two governmental research centers (polymer and plastic) in Tripoli over a period of about five months (March - July), concluded that of 330 participants, 156 knew about nanotechnology and 174 have no idea. Also, A study conducted by Toqeer et al. (2015) in Pakistan, revealed that the majority of the respondents (77%) had heard about nanotechnology but only (47%) had read about it and a slightly lower percentage (44.4%) had an awareness of the applications of nanotechnology. Nurettin and Emel (2013) investigated Turkish middle school students' awareness, factual knowledge, opinions, and risk perceptions toward nanotechnology. The results showed that there is no significant difference between males and females in the level of awareness about nanotechnology. However, for some of the demographic and affective domain factors, and achievement in science courses, significant differences were found.

The main problem in this study is that the development of any nation depends largely on the level of its technological advancement and the level of the exposition of its citizens to the use of modern technology. Modern technology such as Nanotechnology is of great importance to society. Knowledge and application of Nanotechnology can be achieved through the faculty of Agriculture instruction, more especially as naturally occurring nanomaterial existed in ashes and smoke which man is familiar with but ignorant of it as a nanomaterial. And the lack of studies about the perceptions and knowledge of agricultural students in Jordan, despite the vital role that the agricultural faculties' students play in raising awareness of agriculture-related issues there is a lack in studies knowledge about the subject. In addition, in Jordan studies have been conducted targeting agriculture regarding practical, but the studies to Student awareness are few in the nanotechnology. Nanotechnology is related to Agriculture Education, but how much of Nanotechnology is being knowledge and perception in faculty of Agriculture by the students, Therefore, understanding, knowledge, and perception of the Jordanian students from faculty of agriculture toward Nanotechnology

Given this work, the objective of the present study is to examine the perception and knowledge of the Jordanian students of agricultural university faculties, as they considered as the best sample for such study, as these students are the future leaders and at the same time conscious segment of the citizens. The objectives of this study are as follow: This was achieved through, (1) To explore whether the university students are familiar with the 'nanotechnology', (2) To determine their level of knowledge regarding 'nanotechnology', (3) To find out

their perception about nanotechnology, and To identify the relationships of familiarity with nanotechnology with the respondents' demographics.

2. Nanotechnology in Jordan

Jordan among the Middle East, considered as an economically and politically stable country compared to other states. The overall youth literacy rate is 99.22%. Youth literacy rate definition covers the population between the ages of 15 to 24 years (World Bank, 2019). In the early 1960s, Jordan realized the importance of science and technology to the socio-economic development of the country so the Scientific Research Council was established in 1961. The council was responsible for planning, promoting, and financing research; identifying the national research priorities; promotion of scientific research culture; and enhancing science and technology cooperation with the other countries (Alfeeli et al., 2013). The Jordanian educational system is well-developed. UNESCO ranked Jordan education system 18th out of 94 nations in 2018. The rate of public spending on public education in Jordan as a percentage of the government budget in 2018 was 12.2%, Jordan has 29 universities and 40 community colleges. There are over 342,000 Jordanian students enrolled in universities. An additional 35,000 Jordanians pursue higher education abroad (MOHE, 2020). In Jordan there is considerable interest in the development and production of nanotechnology; where major institutes were established such as: "Nanotechnology Research Center" at the Jordan University of Science and Technology/Irbid, and Hamdi Mango Center for Scientific Research at the University of Jordan in Amman, in addition to the Royal Scientific Society. There are also many different efforts in Jordanian universities in scientific research on nanotechnology. At least, 200 scientific publications were published in the field of nanotechnology by Jordanian scientists (UNEP, 2018). The majority of nanotechnology research articles were published by academics at public and private universities. Public institutions account for about 97% of the total published articles, while private institutions contribute to the rest. The University of Jordan and Jordan University of Science and Technology were the pioneers in the field of nanotechnology with more than half the total published articles (Alshamaileh et al., 2016).

3. Materials and Methods

3.1 Population and Sample

In Jordan, three public universities and one private offer Agricultural Studies through a Faculty of Agriculture in each one of these universities. The four universities include The University of Jordan in the Middle Province of Jordan, Mutah University in the Southern Province of Jordan and Jordan University of Science and Technology as well as Jerash University (Northern Province of Jordan). A total of 4534 students study at undergraduate and graduate levels at these four universities resembled the population of the present study. A well-structured questionnaire was electronically administered to all of the 4534 students. A total of 485 students responded (around 11% of the population). The respondents' volume considered being enough as a sample. According to Gay et al. (2006), "If the population is 50,000, a sample of 1% would be more than adequate". The sample size was 485 out of 4534, thus the sample size for the present study is more than adequate that can truly represent the total population. Table 1 shows respondents' distribution among the included universities. The returned rate was only 10.7% due to the spread of coronavirus and due to the conduction of online learning in all universities in Jordan during the period of data collection. Data from 410 respondents were analyzed as 75 questionnaires were found incomplete.

Table 1. Respondents distribution among the investigated universities

University	Frequency	Percent (%)
Jerash University (JU)	166	40.5
Jordan of University (UJ)	51	12.4
Mutah University (MU)	82	20.0
Jordan University of Science and Technology (JUST)	64	15.6
Al-Balqa' Applied University (BAU)	47	11.5
Total	410	100

Source: Authors preparation.

3.2 Data Collection and Analysis

A well-structured questionnaire was designed to obtain information from respondents. The questionnaire contained items related to the demographic and personal characteristics of the respondents, items related to nanotechnology perception and knowledge, and items related to student's attitudes regarding Nanotechnology. The items included in the questionnaire have been developed regarding previous researches on' views on nanotechnology. The questionnaire validity was tested and a Cronbach's value of 0.81 was obtained indicating high reliability of the questionnaire. The questionnaire was translated into Arabic due to the presence of English language difficulties among the participants.

Data analysis was conducted using Statistical Package for Social Sciences software SPSS (version 26). The analysis was descriptively focused on examining relationships between variables. One-way statistical differences due to gender, specialization, and academic level were determined using Student t-tests, one-way ANOVA, and LSD multiple comparisons test. To measure perceptions of students towards nanotechnology, respondents were asked to provide their overall assessments of their understanding and knowledge, about nanotechnology. The assessment was based on their degree of agreement with the statements related to nanotechnology using a five-point Likert -type scale ranging from 1 = not agree to 5 = totally agree.

3.3 Study Variables

Dependent Variables: Understanding, Knowledge, and Perception of the Jordanian Agricultural Students toward Nanotechnology at Universities in Jordan.

Independent Variables: Gender, specialization, academic level, educational stage (to be indicated as undergraduate or graduate).

4. Results and Discussions

4.1 Demographics of the Participants

The results of the study revealed that 53.2% of the participants were male and 46.8% were female. The result also revealed that 14.4% of the participants were fresh students, 24.4% and 24.9% were in the second and third-year levels respectively and 28.8% were in the final stage of the study. The results showed that 92.4% are undergraduate students while 7.6% were postgraduates. According to results, the majority of students were in Food Science and Nutrition (42.7%) specialization, followed by (26.6%) Plant Production, and only (0.50%) of the students were in Landscaping and Floriculture specialization. Table 2 presents the demographic data of the participants.

Table 2. Demographics of the participated students

Variables		Frequency	Percent (%)
Gender	Male	218	53.2
	Female	192	46.8
Educational level	Under-graduate	379	92.4
	Post-graduate	31	7.6
Year of study	First	59	14.4
	Second	100	24.4
	Third	102	24.9
	Fourth	118	28.8
	Above as post graduate	31	7.6
Specialization	Food and nutrition/food technology	175	42.7
	Agricultural economics and extension/agricultural economics and extension	21	5.1
	Animal products	59	14.4
	Plant production	109	26.6
	Horticulture and crop science	21	5.1
	Land, water, and environment	15	3.7
	Biotechnology and genetic	8	2.0
	Landscaping and floriculture program	2	0.5

Source: Statistical analysis output.

4.2 Familiarity With 'Nanotechnology' Concept

Table 3 shows participants' responses to the question of whether they have heard the word 'nanotechnology' before. The results showed that 45.4% of the participants replied that they have heard the word 'nanotechnology' before, while 14.4% of them stated that they never heard the word before. About 33% of the participants replied that they might have heard, and the rest (7.6%) were not sure whether they have heard this word or not. About 47% from Jerash University heard nanotechnology, and 49% from students of (UJ) heard the word, while, 40.2% of respondents were from Mutah University, furthermore, 7.8% respondents from (JUST) never heard the word. This results agrees with Toqeer et al. (2015) in Pakistan, who revealed that the majority of the respondents (77%) had heard about nanotechnology but only (47%) had read about it and a slightly lower percentage (44.4%) had an awareness of the applications of nanotechnology. It is very aspiring to reveal that Jordanian university-level students are the perception of nanotechnology as more than 45% of the total respondents in this study had already heard the word 'nanotechnology', while 32% had might have heard the term, this means that when the student increases their learning and expand their knowledge in science, this will be reflected in his understanding of the terminology.

Table 3. Participants Distribution According to Familiarity with the word 'nanotechnology'

University	Familiarity	Frequency	Percent
Jerash University	I have heard	78	47.0
	I might have heard	57	34.3
	I have never heard	21	12.7
	Not sure	10	6.0
	Total	166	100.0
University of Jordan	I have heard	25	49.0
	I might have heard	15	29.4
	I have never heard	6	11.8
	Not sure	5	9.8
	Total	51	100.0
Mutah University	I have heard	23	28.0
	I might have heard	33	40.2
	I have never heard	18	22.0
	Not sure	8	9.8
	Total	82	100.0
JUST	I have heard	34	53.1
	I might have heard	21	32.8
	I have never heard	5	7.8
	Not sure	4	6.3
	Total	64	100.0
Al-Balqa	I have heard	26	55.3
	I might have heard	8	17.0
	I have never heard	9	19.1
	Not sure	4	8.5
	Total	47	100.0
Overall	I have heard	186	45.4
	I might have heard	134	32.7
	I have never heard	59	14.4
	Not sure	31	7.6
	Total	410	100

Source: Statistical analysis output.

4.3 Source of Knowledge

Figure 1 shows the results related to the source of the participants' knowledge about nanotechnology. The results indicated that 17.9% of the participants confirmed that the source of their knowledge about nanotechnology is personal knowledge, and 40.9% confirmed that their knowledge is from the media, while 24.6% confirmed that

the source of their knowledge is from the university courses that they studied at the university, and 16.6% is from scientific researches. The academic background of the students has been shown to play a major role in shaping their perception and knowledge regarding any technology (Weisenfeld & Ingrid, 2011). It was found that academic courses and Social media had significant role to make students aware of nanotechnology. This might be regarding to that some students are now using smart apps and social media to attract knowledge and distance learning. Therefore, it can be assumed that the students got such information from other types of scientific research and personal knowledge.
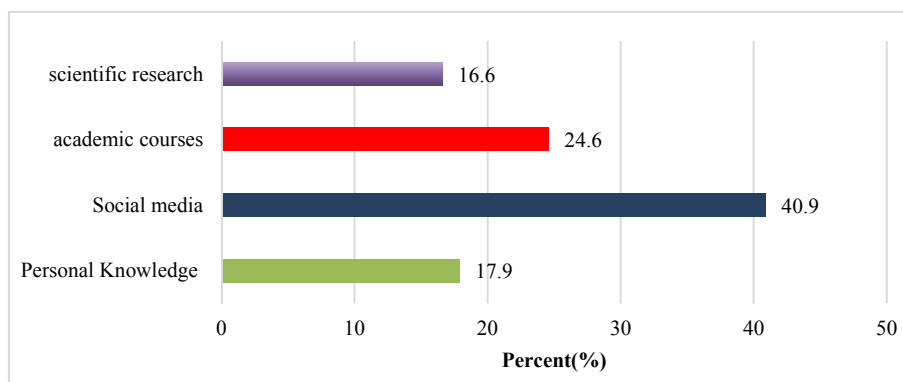

Figure 1. Percentage distribution of sourced of knowledge about nanotechnology

Source: Statistical analysis output.

Table 4 shows the calculated mean scores for the Level of Knowledge in the investigated universities (1.37, 1.37, 1.35, 1.20, and 1.26 respectively), with their respective standard deviations (SD) as 0.607, 0.564, 0.596, 0.477 and 0.488 respectively. These mean scores fall below the accepted mean score (1.5); hence there is a low level of knowledge of nanotechnology among agricultural faculties students. The result of the t-test showed that there is a significant difference between the nanotechnology knowledge levels among students at 0.05 level of significance. Waldron et al. (2006) have found a limited understanding of nanotechnology, in 60% of their research participants.

Table 4. Distribution responding among on knowledge

University	Level	Frequency	Percent	Mean	S.D.	T	Sig.
Jerash University (JU)	Low	115	69.3	1.37	0.607	13.293	0.000
	Med	40	24.1				
	High	11	6.6				
	Total	166	100.0				
University of Jordan (UJ)	Low	34	66.7	1.37	0.564	7.941	0.000
	Med	15	29.4				
	High	2	3.9				
	Total	51	100.0				
Mutah University (MU)	Low	58	70.7	1.35	0.596	9.825	0.000
	Med	19	23.2				
	High	5	6.1				
	Total	82	100.0				
Jordan University of Science and Technology (JUST)	Low	53	82.8	1.20	0.477	13.353	0.000
	Med	9	14.1				
	High	2	3.1				
	Total	64	100.0				
Al-Balqa' Applied University (BAU)	Low	36	76.6	1.26	0.488	10.470	0.000
	Med	10	21.3				
	High	1	2.1				
	Total	47	100.0				
Overall	Low	296	72.2	1.30	0.569	23.857	0.000
	Med	93	22.7				
	High	21	51				
	Total	410	100				

Source: Statistical analysis output.

In Table 4, 72% of the respondents know a low about nanotechnology. The students who know about nanotechnology could answer that nanotechnology can be utilized in the field of science such as agriculture and others. Therefore, policymakers should consider to take initiative to make students and other stakeholders informed about nanotechnology. Such an initiative will enable policymakers to help raise public awareness, provide information regarding research findings, provide input for future policymaking, and attract younger people to science, etc. The Jordanian policymakers can consider the Planning Guide for the organization in nanotechnology developed (OECD, 2012).

4.4 Nanotechnology Importance to Be Included Within the Agricultural Disciplines at the University Level

Based on the results of Figure 1, Figure 2 shows the majority of students (82.9%) in the Faculties of Agriculture in Jordanian universities confirmed that they did not study nanotechnology subjects within the curricula in agriculture faculty in the course. This is reflected to adding nanotechnology courses, part two in this figure, it can be seen that (85.5%) of the respondents who have there is importance to include nanotechnology in the curricula of the Faculty of Agriculture, because of its importance in all applied sciences**.** This means, there is a necessity to update agriculture college science curricula by integrating nanotechnology-related concepts that are both relevant and meaningful to students. The integration of nanotechnology in agriculture science curricula comes in response to nanotechnology development and our mission as educators to instill and arouse students' curiosity in learning about both what is and what will be more dominantly occupying the marketplace (Ghattas & Jeffrey, 2012).
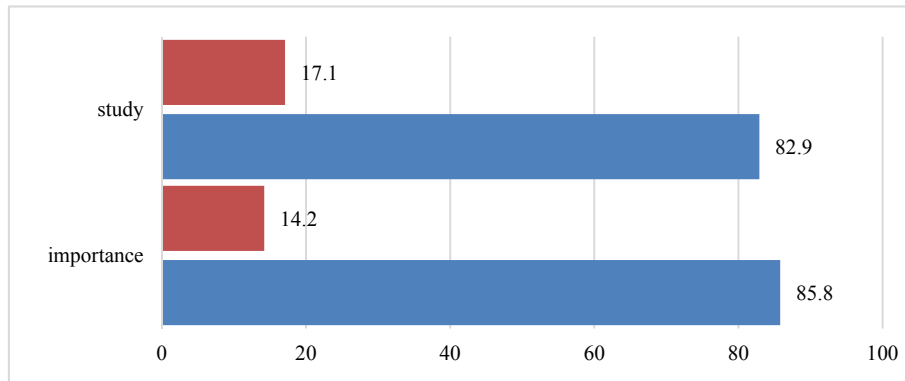
Figure 2. Study and Importance of nanotechnology in course

Source: Statistical analysis output.

4.5 Perception of Nanotechnology

The results of the statistical analysis regarding students' perceptions of Nanotechnology are presented in Table 5. The table shows the mean scores and standard deviations of respondents. The results revealed that the overall mean score is 3.44 which is more than the judgment score value (3). According to the decision rule that serves to judge students' perception, the overall mean score value indicates that we can accept the null-hypothesis. (No significant difference between students perception of nanotechnology at less than or equal 0.05) (t = 10.018, Sig = 0.000). Results in Table 5 also show that the maximum mean score (3.61) of Al-Balqa' Applied University students indicating a high level of nanotechnology perception. This was followed by (3.52) for JUST students, then Jerash students with (3.47), and (3.32) for the students of the University of Jordan, and least perception (3.28) for Mutah University students.

Table 5. Mean scores and standard deviations of respondents' answers

N	Items	Jerash University (JU)				University of Jordan (UJ)				Mutah University(MU)				Jordan University of Science and Technology (JUST)				Al-Balqa' Applied University (BAU)			
		Mean	S.D.	t-value	Sig.	Mean	S.D.	t-value	Sig.	Mean	S.D.	t-value	Sig.	Mean	S.D.	t-value	Sig.	Mean	S.D.	t-value	Sig.
1	Must be encouraged to the Nanotechnology and developed in all fields	3.49	1.07	5.939	0.000	3.41	1.01	2.677	0.010	3.32	1.23	2.323	0.023	3.59	1.08	4.461	0.000	3.60	1.24	3.280	0.002
2	Contributes the Nanotechnology to providing production throughout at a lower cost	3.50	0.98	6.433	0.000	3.47	1.07	3.156	0.003	3.20	1.15	1.645	0.104	3.56	1.12	4.000	0.000	3.68	1.20	3.891	0.000
3	Nano applications improve the entire food production, starting from the production process into the packaging process.	3.49	0.99	6.433	0.000	3.47	1.06	3.156	0.003	3.21	1.14	1.645	0.104	3.56	1.12	4.000	0.000	3.69	1.19	3.891	0.000
4	Nanotechnology helps to increase the ability of plants to nutrient absorption and fertilizers	3.49	0.98	6.473	0.000	3.35	1.07	2.347	0.023	3.37	1.12	3.032	0.003	3.62	1.10	4.523	0.000	3.59	1.11	3.659	0.001
5	Nanomaterials can increase the characteristics of the agricultural soil and its fertility, which increase the growth of plants and increase cro1.07p production.	3.45	0.96	6.043	0.000	3.43	1.00	3.065	0.004	3.28	1.17	2.155	0.034	3.53	1.20	3.518	0.000	3.65	1.12	4.008	0.000
6	Nanomaterials are eco-environmentally sustainable	3.42	0.96	5.585	0.000	3.11	1.12	0.747	0.459	3.31	1.16	2.467	0.016	3.35	1.21	2.370	0.001	3.34	1.12	2.001	0.051
7	Nanoparticles can be used for multiple plant protection purposes, such as pathogen detection, pest control, weed control, pesticide.	3.43	1.01	5.419	0.000	3.12	0.84	1.000	0.322	3.24	1.13	1.939	0.56	3.43	1.13	3.073	0.021	3.48	1.11	3.048	0.004
8	Nanomaterials can be used for Fertilizers as an effective alternative to conventional fertilizers.	3.44	1.02	5.430	0.000	3.21	0.98	1.562	0.125	3.26	1.11	2.185	0.032	3.48	1.23	3.139	0.003	3.63	1.15	3.805	0.000
9	Nanotechnology has great potential to be used in wastewater treatment.	3.54	1.05	7.200	0.000	3.33	1.03	2.305	0.025	3.35	1.12	2.544	0.006	3.60	1.04	4.650	0.000	3.82	1.10	5.127	0.000
	Overall by faculty	3.47	0.81	7.611	0.000	3.32	0.81	2.840	0.006	3.28	0.99	2.300	0.011	3.52	0.96	4.392	0.000	3.61	0.98	4.272	0.000

Source: Statistical Analysis Output.

4.6 Perception According to Gender

According to the results presented in Table 6 below, among the 410 students; 218 were males and 132 were females with mean scores of 3.50, and 3.38 for males and females perceptions respectively. The results indicated that there is no significant difference between males and females' perception of nanotechnology ($p = 0.182 > 0.05$). Participants were able to identify nanotechnology even though males do have higher mean scores than females.

Table 6. Perception of students with respect to gender

Gender	N	Mean	S.D.	D.F.	t-value	Sig.
Males	218	3.50	0.90	408	1.336	0.182
Females	192	3.38	0.89			
Total	410					

Source: Statistical analysis output.

4.7 Perception According to Educational Stage

Table 7 shows the results of perception analysis according to the students' stage of education (Undergraduate, Master, and Ph.D.). The results presented in the table shows that out of the 408 students, 31 were at the Master

and Ph.D. stage and 379 were at the Bachelor stage. With mean scores of 3.60 for Master and Ph.D. students, and 3.43 for Bachelor students there is no significant difference between students' perception towards nanotechnology (p = 0.288 > 0.05).

Table 7. Perception of students with respect to level education

Gender	N	Mean	S.D.	D.F.	t-value	Sig.
Master and more	31	3.60	0.91	408	1.063	0.288
Bachelor	379	3.43	0.89			
Total	410					

Source: Statistical analysis output.

4.8 Perception According to Gender to a Year of Study

The participants were divided into 5 groups according to their year of study as shown in Table 8. The convergent values of the mean scores for the five groups suggest that there is no significant effect of student year on his or her perception toward nanotechnology. ANOVA test results shown in Table 9 confirm the results obtained in Table 8 with p = 0.175 > 0.05.

Table 8. Students' perception towards nanotechnology according to students' year of study

Level of study	n	Mean	S.D.
First-year	59	3.29	1.02
Second-year	100	3.46	0.73
Third-year	102	3.61	0.90
Fourth-year	118	3.35	0.92
Other	31	3.42	0.95
Total	410	3.44	0.89

Source: Authors own analysis.

Table 9. ANOVA test for Students' Perception towards nanotechnology according to students' year of study

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.117	4	1.279	1.594	.175
Within Groups	324.957	405	.802		
Total	330.074	409			

Source: Authors own analysis.

4.9 Responses With Respect to the Type of University

Table 10 shows the results of students' perceptions according to the location of the investigated universities. The convergent values of the mean scores for the investigated universities suggest that there is no significant effect of the location of the university on students' perception toward nanotechnology. ANOVA test results shown in Table 11 confirm the results obtained in Table 10 with p = 0.175 > 0.05.

Table 10. Students' Perception towards nanotechnology according to the location of the university

Type	n	Mean	S.D.
Jerash University (JU)	166	3.47	.81
Jordan of University (UJ)	51	3.36	.81
Mutah University (MU).	82	3.29	.99
Jordan University of Science and Technology (JUST),	64	3.52	.96
Al-Balqa' Applied University (BAU)	47	3.61	.98
Total	410	3.44	.89

Source: Authors own analysis.

Table 11. ANOVA test for Students' Perception towards nanotechnology according to the location of the university

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.782	4	1.195	1.488	0.205
Within Groups	325.292	405	0.803		
Total	330.074	409			

Source: Authors own analysis.

5. Conclusions and Recommendations

This study was an attempt to assess the knowledge and perception of the agricultural faculties' students among the Jordanian universities. It is a very significant finding that the majority of the investigated students (45%) have already heard the word 'nanotechnology', though (72%) of those (45%) do not know about nanotechnology very well. The results of the present study indicate that students have basic or no enough knowledge about nanotechnology. This confirms the research hypothesis of this study. The results also showed that students were with a very superficial knowledge of nanotechnology. This result is not consistent with the hypothesis of the study. Moreover, none of the examined variables has No significant effect on the perception toward nanotechnology. Although it is expected that students with higher years of study could show more expertise and acquire more developed topics such as the nanotechnology concept, the students showed similar knowledge of nanotechnology regardless of their year in the study. The study recommends that the Jordanian educational policymakers in higher education should consider the inclusion of the nanotechnology concept in the curricula of different academic courses. Future research may also consider the citizens' impression and perception of nanotechnology.

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