STUDENT'S AWARENESS, KNOWLEDGE, AND PERCEPTIONS OF PRECISION AGRICULTURE TECHNOLOGY IN PALESTINIAN AGRICULTURAL FACULTIES

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ABSTRACT: *Precision agriculture (PA), which uses satellite navigation, has emerged to help increase crop yields and improve efficiency. Despite the increase in the body of PA literature, little is known about PA in Palestine. This research aimed to analyze university students' awareness, knowledge, and perceptions towards PA. An item-based questionnaire was designed and distributed online to agriculture college students in Palestine. It was found that, among students (n = 211), the majority had moderate, low, and very low level of knowledge and awareness (85%) of PA. While the majority of students (77%) had either strongly agree, agree, and neutral for perceptions toward PA. Generally, the stand of students for PA is positive and there is a strong believe among them that universities have a significant contribution to introduce PA into Palestine, and most students were with the need to develop new courses of PA in Palestine. In addition, there was a significant difference between the five universities' students and study level; further research should focus on analyzing.*

KEYWORDS*: Precision Agriculture; Smart Farming; Education; Internet of Things; Drones*

1 INTRODUCTION

In developed countries, agriculture practices have a tendency to support better energy inputs using machines and intensified use of pesticides and fertilizers. Whereas such intensive agricultural activities have negative environmental, health and economic consequences such as soil pollution, soil fertility deterioration, groundwater water contamination, eutrophication, well as build-up of chemical residues in the fruit crops, as well as increase agricultural input costs, which in turn impacts the sustainable agriculture in negative manner (Folhes et al., 2009; Allahyari et al., 2016). There is an urgent and serious need for shifting to a new production technique that protects the environment, enhances human health and is more sustainable for the new generations. Around the world, PA is substituting the method of how people are used to grow their crops and manage their herds and even after they produce their agricultural products as it offers a multitude of possible gains in cost-effectiveness, yield, sustainable production, environment protection, and rural development. (Liaghat and Balasundram, 2010; Schimmelpfennig, 2018).

PA is a technology-based agricultural system, created to enhance the agricultural practices by accurate monitoring of every step to guarantee reaching higher production with reduced effect on the environment, human health, taking into account the profitability of the farmers. PA focuses on delivering the best way for detection, evaluation and regulating agricultural activities. It deals with a wide range of agricultural issues such as herd management and the agricultural production cycle

(Burrell et al., 2004; Zhang et al., 2004; Thompson et al., 2019). PA includes the regulation of cultivation practices, adjusting the fertilization programming and application and accurate application of irrigation water and irrigation scheduling (Adams et al., 2000).

To achieve this, innovative trends have been developed within the agricultural sector. Appreciations to the improvements in the area of wireless sensor networks as well as the reduction of the size of sensor motherboards, PA kicked off. Several technologies were utilized to produce safer agricultural products and to decrease their unfavorable effects on the environment, an objective that is considered to be in harmony with sustainable agriculture. PA came out as an appreciated module of this structure to accomplish that objective (Liaghat and Balasundram, 2010; Chuang et al., 2020).

As shown in the reports of the Palestinian Ministry of Agriculture (MoA), there are quite a lot of difficulties and challenges to the Palestinian agricultural sector. One of these important challenges is the limitation in the availability of agricultural land, which makes the shifting to a more efficient agriculture a necessity and priority. The second important challenge is the limitation in the availability of freshwater. It should be pointed out that a high percentage of Palestinian farmers use drip irrigation systems to irrigate their fields (MoA, 2014). However, the majority of Palestinian farming system is a traditional system carried out without well prepared plans and without using modern or evolved equipment; which is because of the absence of financial support and training or both. Finally, the number of agronomists is inadequate; this delays the progress in this sector and restricts the use of such advanced technologies in the sector. In addition, local farmers are not well prepared to deal with modern technologies and prefer conventional systems (Abdalla et al., 2019; MoA, 2014). At the same time PA or smart farming are not included in the curricula of the faculties of agriculture in Palestine (Deans of faculties of agriculture in Palestine, personal communication).

Under these circumstances, the employment of advanced technology in the Palestinian agricultural system will have a positive impact. It will lead to improved productivity either by increasing the production quantitatively or qualitatively (Abdalla et al., 2019; MoA, 2014).

Using PA in education in Palestine is still limited. A team of researchers from several Palestinian and European universities, including the authors of this study, participants to the Erasmus+ project entitled "Boosting Innovation in Education and Research of PA in Palestine/ BENEFIT", (609544-EPP-1-2019-1-PS-EPPKA-CBHE-JP), has developed a framework for using PA technology to teach several courses, in all Palestinian agricultural colleges. Through published scientific papers, the team presents perspectives of education in PA and agriculture 4.0 in selected countries in the European Union - Slovakia, Czech Republic, and Palestine (Palková et al., 2021; Palková et al., 2022).

The aim of this study was to identify the level of awareness, knowledge, and perceptions toward PA from the perspective of the students of agricultural colleges' students in Palestine.

2 MATERIALS AND METHODS

2.1 Study Population, Design and Sampling

To perform our study, it was necessary to propose some hypotheses. The tested hypotheses were as follows:

1. Knowledge Level by Gender:
   - Null Hypothesis (H0): There is no significant difference in the knowledge of precision agriculture between male and female Palestinian university students enrolled in agriculture programs.
   - Alternative Hypothesis (H1): There is a significant difference in the knowledge of precision agriculture between male and female Palestinian university students enrolled in agriculture programs.
2. Knowledge Level by Academic Level:
   - Null Hypothesis (H0): There is no significant difference in the knowledge of precision agriculture among Palestinian university students in different academic levels (third grade, fourth grade, or masters) enrolled in agriculture programs.
   - Alternative Hypothesis (H2): There is a significant difference in the knowledge of precision agriculture among Palestinian university students in different academic levels (third grade, fourth grade, or masters) enrolled in agriculture programs.
3. Perception by Academic Level:
   - Null Hypothesis (H0): There is no significant difference in the perception of the need for a precision agriculture curriculum among Palestinian university students in different academic levels (third grade, fourth grade, or masters) enrolled in agriculture programs.
   - Alternative Hypothesis (H3): There is a significant difference in the perception of the need for a precision agriculture curriculum among Palestinian university students in different academic levels (third grade, fourth grade, or masters) enrolled in agriculture programs.
4. Knowledge Level by University:

• Null Hypothesis (H0): There is no significant difference in the knowledge of precision agriculture among Palestinian university students enrolled in agriculture programs at different universities.

• Alternative Hypothesis (H4): There is a significant difference in the knowledge of precision agriculture among Palestinian university students enrolled in agriculture programs at different universities.

5. Perception by University:

• Null Hypothesis (H0): There is no significant difference in the perception of the need for a precision agriculture curriculum among Palestinian university students enrolled in agriculture programs at different universities.

• Alternative Hypothesis (H5): There is a significant difference in the perception of the need for a precision agriculture curriculum among Palestinian university students enrolled in agriculture programs at different universities.

The Table 1 shows the demographic characteristics of Palestinian students used for the study.

Table 1. Demographic Characteristics of Palestinian Students (N = 211)

	f	%
Gender		
Female	112	53.1%
Male	99	46.9%
University		
ANNU	57	27.0%
PTUK	29	13.7%
HU	38	18.0%
AUG	56	26.5%
QOU	31	14.7%
Academic Level		
Third grade	80	37.9%
Fourth grade	99	46.9%
Master	32	15.2%

In a sample of 211 Palestinian students, the distribution of gender revealed that females comprised a slight majority with 53.1% students (*N* = 112), while males accounted for 46.9% students (*N* = 99). When examining the university affiliations, students were primarily from ANNU (*N* = 57, 27.0%), followed by AUG (*N* = 56, 26.5%), HU (*N* = 38, 18.0%), QOU (*N* = 31, 14.7%), and PTUK (*N* = 29, 13.7%). The academic level of participants varied, with fourth-grade students representing the largest group (*N* = 99, 46.9%), third-grade students (*N* = 80, 37.9%), and master's students (*N* = 32, 15.2%). The graphical distribution is shown in Figures 1-3.

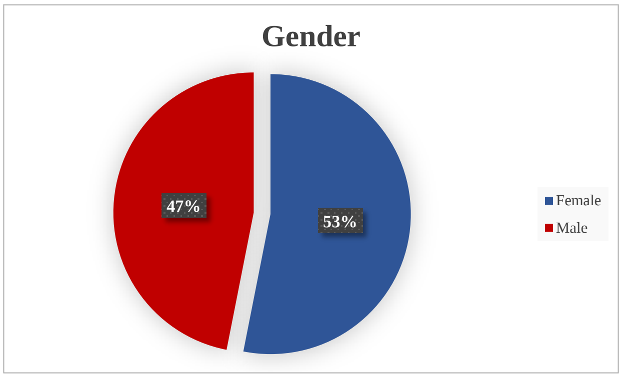

Fig. 1 Pie chart showing gender distribution of Palestinian students in the sample.

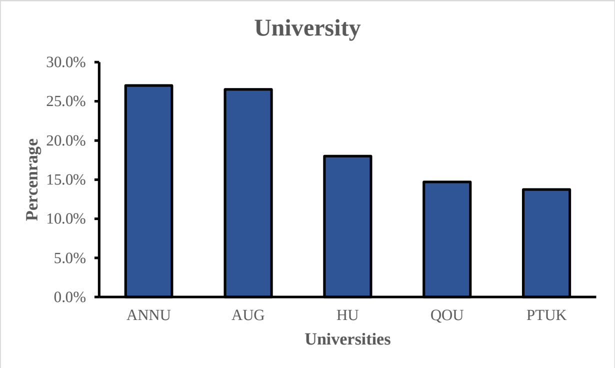

Fig. 2 Bar graph showing the distribution of Palestinian students across different universities.

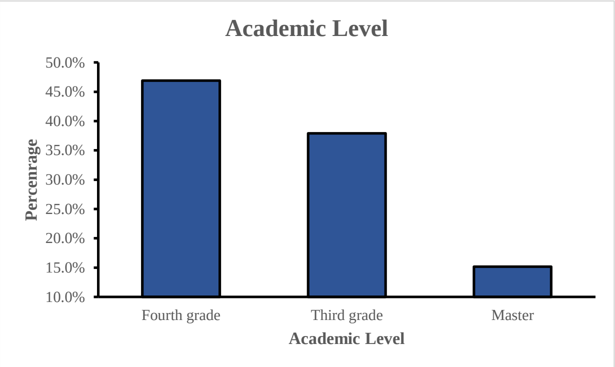

Fig. 3 Bar graph showing distribution of Palestinian students across three different academic levels.

Table 2 presents the descriptive statistics for the ten survey questions used to measure Palestinian university students' perceptions of precision agriculture. All questions were measured on a five-point Likert scale, with 1 indicating "Strongly Disagree" and 5 indicating "Strongly Agree."

The results revealed variations in student perceptions across different aspects of precision agriculture. Questions concerning the need for curriculum development received the highest mean scores. Students displayed the strongest agreement with the statement "I believe that there is a need to develop some of the current study courses to include PA applications" (*M* = 4.42, *SD* = 0.66), followed by "I believe that there is a need to develop new courses of study on PA within my field of specialization" (*M* = 4.39, *SD* = 0.77). These findings suggest a general student desire for increased integration of precision agriculture concepts into their existing coursework.

Conversely, the lowest mean scores were associated with questions regarding the current availability of infrastructure and training opportunities. Students expressed the least agreement with the statements "I think the infrastructure for PA is available in my department and university" (*M* = 2.81, *SD* = 1.03) and "Training opportunities on PA and its applications are available" (*M* = 2.82, *SD* = 1.05). These results suggest that students perceive a lack of readily accessible resources for learning about and implementing precision agriculture practices.

The table further shows the skewness and kurtosis values for each question. Skewness ranged from -1.30 to 0.42, indicating that the data distribution for most questions was relatively symmetrical.

Table 2. Descriptive Statistics of Student Perceptions on Precision Agriculture (N = 211)

	Mean	SD	Min	Max	Skewness	K
Training opportunities on PA and its applications are available	2.82	1.05	1	5	0.42	
Find different information sources to develop my knowledge about PA and its applications	3.85	0.85	1	5	-0.65	
Interested in knowing appropriate solutions provided by PA to the problems of agriculture within the local environment	3.96	0.78	2	5	-0.53	
I believe that there is a need to develop new courses of study on PA within my field of specialization	4.39	0.77	1	5	-1.30	
I believe that there is a need to develop some of the current study courses to include PA applications	4.42	0.66	3	5	-0.71	
I think the infrastructure for PA is available in my department and university	2.81	1.03	1	5	0.11	
I think that PA is far from being applied in my field of specialization.	3.11	1.22	1	5	-0.15	
I am thinking of doing a graduation project in the framework of PA	3.30	1.01	1	5	0.03	
I think that the general environment of the Palestinian reality constitutes a suitable incubator for PA	3.30	0.93	1	5	-0.18	
I believe that PA is the future of agriculture inevitably	4.09	0.81	2	5	-0.43	

The mean scores of the ten-question measuring perception of Palestinian students on precision agriculture is shown in Figure 4.

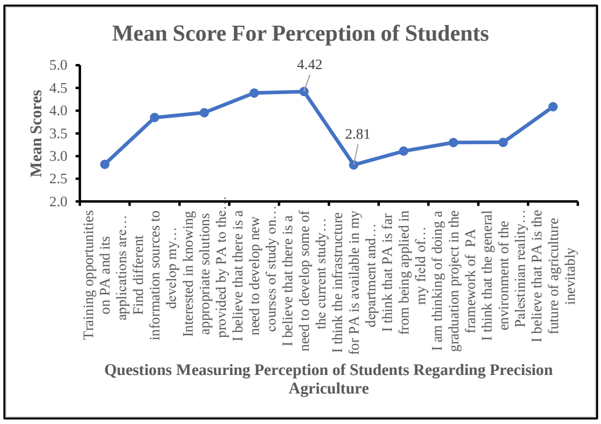

Fig 4. Line graph showing mean scores of the ten-question measuring perception of Palestinian students on precision agriculture

Table 3. Descriptive Statistics of Student Knowledge and Skills on Precision Agriculture (N = 211)

	Mean	SD	Min	Max	Skewness	Kurtosis
How familiar are you with smart farms?	2.68	0.86	1	5	0.06	0.31
How familiar are you with the use of smart farming automated control system?	2.52	0.89	1	5	0.35	0.02
How familiar are you with the use of GPS guidance systems in smart agriculture?	2.41	0.94	1	5	0.64	0.41
How familiar are you with the use of electronic applications (Apps) in smart agriculture?	2.45	0.97	1	5	0.48	0.20
How familiar are you with the use of Big Data technology in smart agriculture?	2.19	0.88	1	5	0.64	0.45
How familiar are you with the use of image recognition technology in smart agriculture?	2.51	0.93	1	5	0.46	0.22
How familiar are you with the applications of sensors and monitoring in smart agriculture?	2.52	0.93	1	5	0.15	-0.40
How familiar are you with the application of wireless sensor networks in precision agriculture?	2.28	0.91	1	5	0.53	0.08
How well do you know how to use robotic in smart agriculture?	2.16	0.85	1	4	0.20	-0.72
How familiar are you with the use of drones in smart agriculture?	2.15	0.86	1	5	0.34	-0.32
How familiar are you with using the Internet of Things (IoT) in smart agriculture?	2.24	0.95	1	5	0.67	0.33
How familiar are you with the applications of smart systems in the management of livestock farms?	2.39	0.97	1	5	0.43	0.01
How much do you know about spectroscopy and computer vision in growing crops?	2.06	0.83	1	5	0.69	0.93
How familiar are you with the applications of measuring temperature, humidity, and wind speed (Meteorological Data)?	2.62	1.05	1	5	0.20	-0.54
How much do you know the scientific knowledge that makes me able to understand and work with smart farming techniques?	2.52	0.99	1	5	0.36	-0.18
How much do you know about Climate Smart Agriculture and how it differs from Smart Agriculture?	2.27	0.87	1	5	0.21	-0.19
How familiar are you with the programming of smart farming techniques?	2.19	0.86	1	4	0.36	-0.46
How well do you know that you possess the scientific knowledge and skills that make you able to work as a mentor in the field of smart agriculture?	2.44	0.97	1	5	0.33	-0.21
knowledge and skills to work as a representative for a company marketing SAT	2.50	1.06	1	5	0.42	-0.18

Table 3 presents the descriptive statistics for the nineteen survey questions used to measure Palestinian university students' knowledge and skills related to precision agriculture. All questions were measured on a five-point Likert scale, ranging from 1 ("Very Low") to 5 ("Very High").

The results revealed a mixed picture of student knowledge and skills in various precision agriculture domains. While some questions showed a basic level of familiarity, others indicated a need for improvement. Students demonstrated the highest average familiarity with "smart farms" (*M* = 2.68, *SD* = 0.86), followed by "applications of measuring temperature, humidity, and wind speed (Meteorological Data)" (*M* = 2.62, *SD* = 1.05). These scores, however, fall between "Low" and "Average" on the Likert scale, suggesting a need for improvement in foundational knowledge of these core precision agriculture aspects.

Conversely, student responses indicated the lowest familiarity with "spectroscopy and computer vision in growing crops" (*M* = 2.06, *SD* = 0.83) and "use of drones in smart agriculture" (*M* = 2.15, *SD* = 0.86). These findings suggest a potential knowledge gap in areas requiring deeper technical understanding.

The table further shows the skewness and kurtosis values for each question. Skewness ranged from 0.06 to 0.67, indicating that the data distribution for most questions was relatively symmetrical. However, further analysis of individual questions with significant skewness values might be warranted to explore potential biases in student responses. Figure 5 shows the mean scores of the nineteen questions measuring knowledge and skills of Palestinian students on precision agriculture.

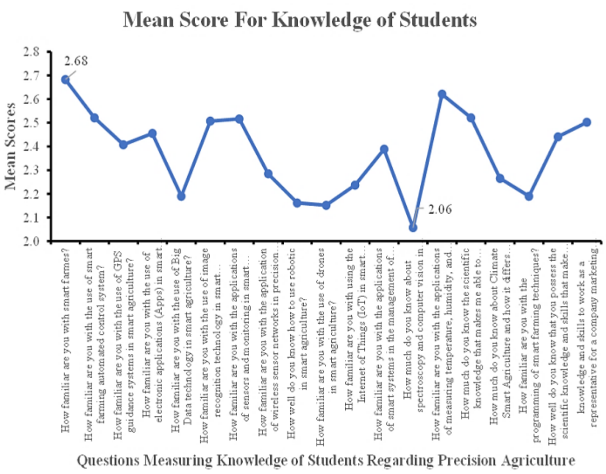

Fig 5. Line graph showing mean scores of the nineteen questions measuring knowledge and skills of Palestinian students on precision agriculture

Table 4 presents Cronbach's alpha coefficients for the two measurement scales used in the study. Cronbach's alpha is a measure of internal consistency, indicating the degree to which items within a scale assess the same underlying construct.

The "Knowledge and Skills" scale, comprised of nineteen items, demonstrated a satisfactory level of internal consistency with a Cronbach's alpha of .961. The "Perception" scale, initially containing ten items, underwent a modification. Question 7, worded as "I think that PA is far from being applied in my field of specialization," was removed due to its negative impact on the overall scale reliability. Following this removal, the revised "Perception" scale with nine items yielded a high Cronbach's alpha of .705, indicating a strong level of internal consistency.

Table 4. Cronbach's Alpha Reliability Coefficients for Knowledge and Skills and Perception Scales

Scale	No of Items	Alpha
Perception	9	0.705
Knowledge and Skills	19	0.961

An independent samples t-test was performed to evaluate gender differences in perception and knowledge and skills related to precision agriculture (PA) among Palestinian students (Table 5). In terms of perception, there was a statistically significant difference between females (*M* = 3.59, *SD* = 0.49) and males (*M* = 3.74, *SD* = 0.46); (*t* (209) = -2.26, *p* < .05), with a small effect size (Cohen's d = 0.31). This suggests that male students have a slightly higher perception of PA than female students.

Table 5. Gender Differences in Knowledge and Perception of Precision Agriculture

	Female		Male				
Scales	M	SD	M	SD	t (209)	p-value	Cohen's d
Perception	3.59	0.49	3.74	0.46	-2.26	<.05	0.31
Knowledge and Skills	2.17	0.56	2.61	0.75	-4.79	<.001	0.67

In terms of perception, there was a statistically significant difference between females (*M* = 3.59, *SD* = 0.49) and males (*M* = 3.74, *SD* = 0.46); (*t* (209) = -2.26, *p* < .05), with a small effect size (Cohen's d = 0.31). This suggests that male students have a slightly higher perception of PA than female students.

Regarding knowledge and skills, a significant difference was also found between females (*M* = 2.17, *SD* = 0.56) and males (*M* = 2.61, *SD* = 0.75); (*t* (209) = -4.79, *p* < .001), with a medium effect size (Cohen's d = 0.67). This indicates that male students reported higher levels of knowledge and skills in PA compared to their female counterparts.

These findings suggest that gender differences exist in both the perception of and the self-reported knowledge and skills in PA, with males scoring higher in both domains. The implications of these differences warrant further investigation to understand the underlying factors contributing to this disparity and to develop strategies to enhance PA education for all students. Therefore, hypothesis 1, which stated that there is a significant difference in the knowledge of precision agriculture between male and female Palestinian university students enrolled in agriculture programs, is supported. The Mean differences in students' perception and knowledge and skills on precision agriculture based on gender is shown in Figure 6.

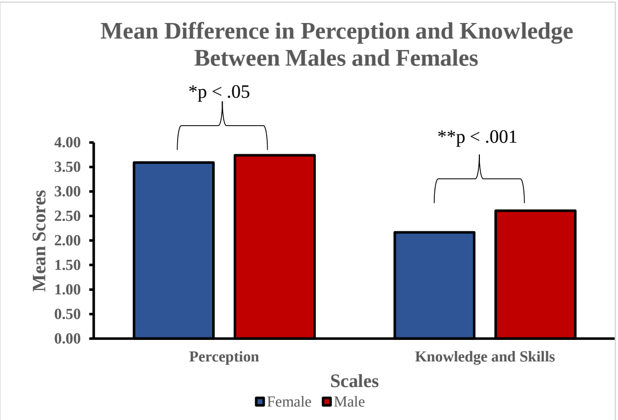

Fig 6. Mean differences in students' perception and knowledge and skills on precision agriculture based on gender.

Table 6. Gender Differences in Knowledge and Perception of Precision Agriculture

Scales	ANNU	PTUK	HU	AUG	QOU	F(4,206)	p-valu
Perception	3.50_a (.51)	3.72_b (.44)	3.55_c (.46)	3.78_a (.45)	3.80_e (.45)	3.745	<.0
Knowledge and Skills	2.16_a (.63)	2.24_b (.65)	2.27_c (.47)	$2.77_{a,b,c,e}$ (.73)	2.32_e (.75)	7.207	<.00

Note. Means Sharing common subscripts are significantly different from each other

A one-way ANOVA was performed to assess the differences in perception and knowledge and skills related to precision agriculture (PA) among students from various universities. For perception, the ANOVA results indicated a significant effect of university on student perceptions of PA, (*F* (4, 206) = 3.745, *p* < .01). A Tukey HSD post hoc test revealed that this difference was primarily between students from ANNU (*M* = 3.50, *SD* = 0.51) and AUG (*M* = 3.78, *SD* = 0.45), with AUG students showing a higher perception of PA.

In terms of knowledge and skills, the ANOVA was also significant, (*F* (4, 206) = 7.207, *p* < .001). The Tukey HSD post hoc test indicated that students from AUG (*M* = 2.77, *SD* = 0.73) had significantly higher knowledge and skills in PA compared to their counterparts from ANNU (*M* = 2.16, *SD* = 0.63), PTUK (*M* = 2.24, *SD* = 0.65), HU (*M* = 2.27, *SD* = 0.47), and QOU (*M* = 2.32, *SD* = 0.75).

These results suggest that there are significant differences in both perception and knowledge and skills in PA among students from different universities, with AUG students demonstrating higher levels in both domains. This may reflect the influence of university-specific curricula, resources, and emphasis on PA education. The findings highlight the importance of university education in shaping students' perceptions and knowledge of PA. Therefore, hypotheses 4 and 5 are supported. Graphical representation of the findings are shown in Figure 7 and 8.

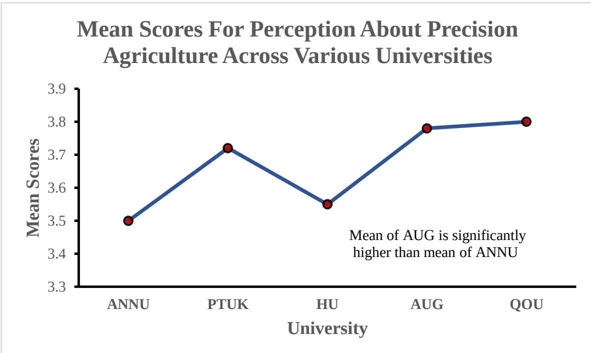

Fig 7. Line graph showing mean scores for perception of Palestinian students about precision agriculture based on various universities.

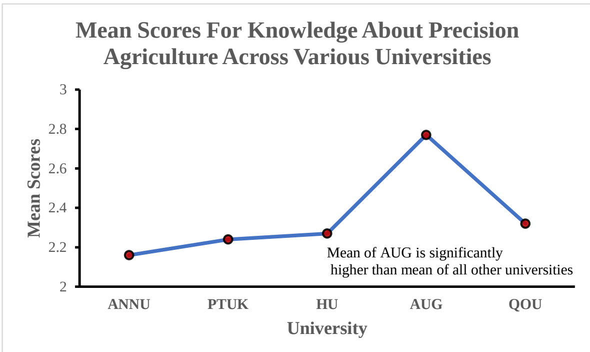

Fig 8. Line graph showing mean scores for knowledge of Palestinian students about precision agriculture based on various universities.

A one-way ANOVA was utilized to determine if there were significant differences in perception and knowledge and skills related to precision agriculture (PA) among Palestinian students at different academic levels. The analysis for perception indicated no significant differences across the academic levels, (F (2, 208) = 0.150, p = .861). Similarly, for knowledge and skills, the results were not statistically significant, (F (2, 208) = 1.706, p = .184). Therefore, hypotheses 2 and 3 are not supported.

These findings suggest that the academic level—whether third grade, fourth grade, or master's—does not significantly influence students' perception of or knowledge and skills in PA. This lack of significant difference implies that students across these academic levels have a relatively uniform perception and understanding of PA, which could be attributed to consistent exposure to PA concepts throughout their education. The results indicate that further educational interventions in PA should be designed with consideration for factors other than academic level. The graphical representation is shown in Figure 9 and 10.

Table 7. Results of One-Way ANOVA between Academic Levels and Perception and Knowledge and Skills Scales regarding Precision Agriculture among Palestinian University Students

Scales	Third Grade	Fourth Grade	Masters	F(2,208)	p-value
Perception	3.65 (.48)	3.65 (.49)	3.70 (.48)	0.150	0.861
Knowledge and Skills	2.37 (.77)	2.44 (.65)	2.18 (.59)	1.706	0.184

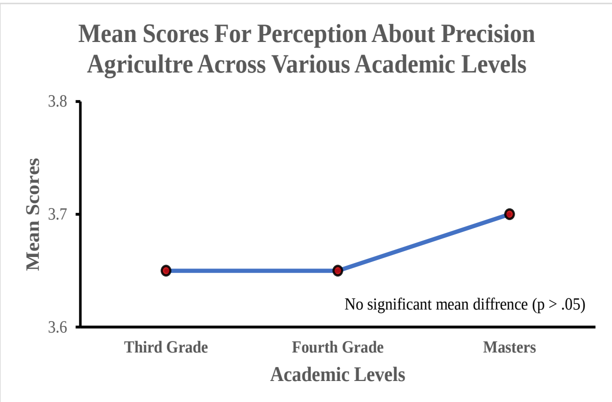

Fig 9. Line graph showing mean scores for perception of Palestinian students about precision agriculture based on various academic levels.

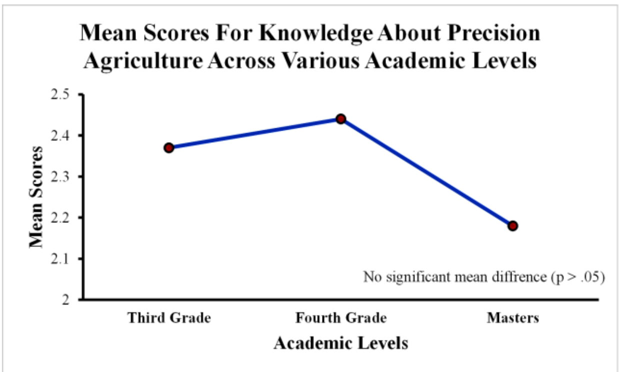

Fig 10. Line graph showing mean scores for knowledge and skills of Palestinian students about precision agriculture based on various academic levels.

Table 8. Frequency Distribution of Perception Scale Scores Among Palestinian Students

Mean scores	Frequency	Percent	Cumulative Percent
2.44	1	0.5	0.5
2.56	2	0.9	1.4
2.67	4	1.9	3.3
2.78	6	2.8	6.2
2.89	2	0.9	7.1
3.00	8	3.8	10.9
3.11	9	4.3	15.2
3.22	13	6.2	21.3
3.33	18	8.5	29.9
3.44	17	8.1	37.9
3.56	12	5.7	43.6
3.67	23	10.9	54.5
3.78	17	8.1	62.6
3.89	17	8.1	70.6
4.00	20	9.5	80.1
4.11	10	4.7	84.8
4.22	9	4.3	89.1
4.33	8	3.8	92.9
4.44	8	3.8	96.7
4.56	5	2.4	99.1
4.67	1	0.5	99.5
4.78	1	0.5	100.0

A frequency analysis was conducted on the perception scale to evaluate Palestinian students' attitudes towards precision agriculture (PA). The scale's mean scores ranged from 2.44 to 4.78, with the midpoint of the scale (3.00) indicating a neutral stance. The analysis indicated that a substantial proportion of students (89%; N = 188) scored above this neutral point, suggesting a generally positive perception of PA. However, it is important to note that 43.6% of the students had mean scores of 3.56 or below (N = 92), which does not support the assumption that 50% of Palestinian students have a 'good' perception of PA, as 'good' would be indicated by scores significantly higher than the midpoint. This finding suggests that while there is a tendency towards a positive perception of PA, there is still a considerable portion of the student population that remains neutral or has reservations about PA. Figure 11 shows cumulative percentage of mean score for perception on precision agriculture for Palestinian students.

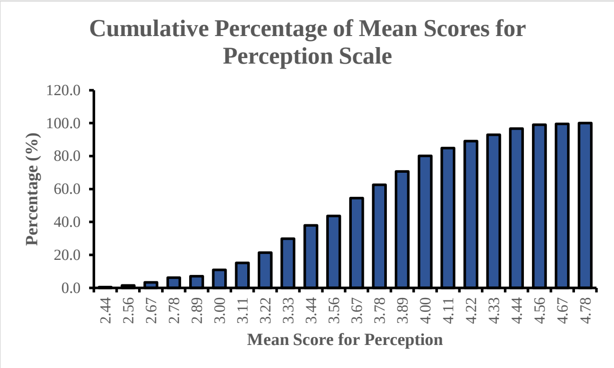

Fig 11. Bar graph showing cumulative percentage of mean score for perception on precision agriculture for Palestinian students.

Table 9. Frequency Distribution of Knowledge Scale Scores Among Palestinian Students

Mean Scores	Freq.	Percent	Cumulative Percent
1.00	9	4.3	4.3
1.05	4	1.9	6.2
1.16	2	0.9	7.1
1.21	1	0.5	7.6
1.26	2	0.9	8.5
1.32	2	0.9	9.5
1.37	2	0.9	10.4
1.42	2	0.9	11.4
1.47	2	0.9	12.3
1.53	2	0.9	13.3
1.58	1	0.5	13.7
1.63	1	0.5	14.2
1.74	4	1.9	16.1
1.84	3	1.4	17.5
1.89	2	0.9	18.5
1.95	3	1.4	19.9
2.00	15	7.1	27.0
2.05	11	5.2	32.2
2.11	13	6.2	38.4
2.16	8	3.8	42.2
2.21	4	1.9	44.1
2.26	10	4.7	48.8
2.32	3	1.4	50.2
2.37	7	3.3	53.6
2.42	5	2.4	55.9
2.47	7	3.3	59.2
2.53	8	3.8	63.0
2.58	7	3.3	66.4
2.63	5	2.4	68.7
2.74	5	2.4	71.1
2.79	7	3.3	74.4
2.84	3	1.4	75.8
2.89	6	2.8	78.7
2.95	2	0.9	79.6
3.00	11	5.2	84.8
3.11	3	1.4	86.3
3.16	3	1.4	87.7
3.21	3	1.4	89.1
3.32	2	0.9	90.0
3.37	4	1.9	91.9
3.42	4	1.9	93.8
3.47	2	0.9	94.8
3.53	1	0.5	95.3
3.58	2	0.9	96.2
3.63	1	0.5	96.7
3.68	1	0.5	97.2
3.84	1	0.5	97.6
3.89	1	0.5	98.1
3.95	1	0.5	98.6
4.00	2	0.9	99.5
4.16	1	0.5	100.0

The distribution of student responses on the knowledge scale was analyzed using frequency analysis. Scores on the five-point Likert scale, ranging from 1 ("Very Low") to 5 ("Very High"), revealed a wider spread compared to the perception scale. Over half of the students (N = 106, 50.2%) scored at or below 2.32. Furthermore, a substantial portion (N = 179, 84.8%) scored 3.00 or lower. A score of 3.00 represents the neutral point on the Likert scale. These findings suggest that a significant majority of students possess knowledge and skills related to precision agriculture that fall within the "Low" to "Somewhat Moderate" range.

This data contradicts the initial assumption that 50% of Palestinian students would demonstrate "good" knowledge of precision agriculture. The results indicate a need for improvement in students' foundational understanding of precision agriculture concepts. Figure 12 shows cumulative percentage of mean score for knowledge and skills on precision agriculture for Palestinian students.

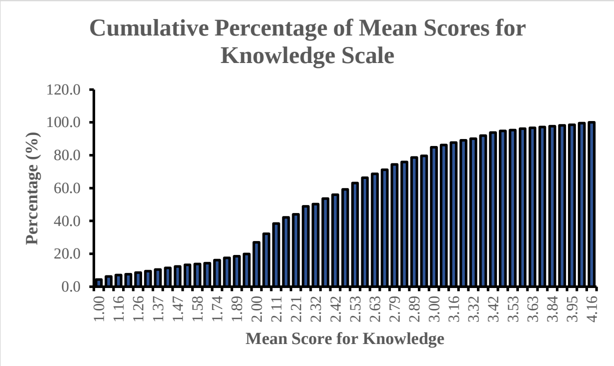

Fig 12. Bar graph showing cumulative percentage of mean score for knowledge and skills on precision agriculture for Palestinian students.

3 DISCUSSIONS OF THE RESULTS

This study investigated Palestinian university students' knowledge, skills, and perception regarding precision agriculture (PA). The findings provide valuable insights into the current state of PA awareness and preparedness among this student population.

Generally, the stand of students for PA is positive and there is a strong believe among them that universities have a significant contribution to introduce PA into Palestine. Students believe that the universities are the main sources to improve the knowledge about PA through practical and theoretical courses and are the best way to enhance their knowledge about PA. This is in agreement with the results reported by Bournaris et al (2022).

Knowledge and Skills

The analysis of the knowledge and skills scale revealed that, on average, students scored within the "Low" to "Average" range. Over half of the participants demonstrated knowledge and skills that fell below the neutral point on the Likert scale. These results suggest a need for significant improvement in students' foundational understanding of PA concepts. While some familiarity was evident with topics like "smart farms" and basic data collection methods, knowledge regarding more advanced technologies like spectroscopy and drone use was limited.

These findings align with previous studies highlighting the limited integration of PA into agricultural education programs in developing countries (Nguyen et al., 2023). The lack of exposure to PA principles and practices within the curriculum may contribute to the observed knowledge gap.

Perception

The perception scale results presented a more positive picture. While the initial assumption of 50% of students exhibiting "good" perception was not entirely supported, a clear trend of agreement with the importance of PA emerged. Nearly 90% of students scored above the neutral point, indicating a general recognition of the need for PA curriculum development and the potential benefits it offers. This positive perception suggests that students are receptive to incorporating PA into their agricultural education.

This is in agreement with the results reported by Reichardt et al. (2009) and Kountios et al (2018). Also Say et al (2018) reported that adoption rate of PA technologies is in an increasing trend in some developed and developing countries.

Interestingly, a significant difference in perception scores was found between universities. Students from ANNU reported a slightly lower perception compared to those from AUG. This might be due to existing initiatives or specific faculty expertise in PA at AUG, potentially leading to greater awareness among students. Further investigation into these university-level variations could be informative.

Gender Differences

A notable finding was the statistically significant difference in knowledge and skills scores between genders. Male students scored moderately higher than females, suggesting a potential gender gap in PA knowledge. Several factors, such as unequal access to educational resources or traditional gender roles within agriculture, could contribute to this disparity. Future research exploring the underlying reasons for this difference is warranted.

4 CONCLUDING REMARKS

The study highlighted the need for increased emphasis on PA education for Palestinian university students enrolled in agriculture programs. While students expressed a positive perception of PA, their knowledge and skills remain at a relatively low level. Curriculum development efforts that integrate PA concepts and provide opportunities for practical application are crucial. Addressing the identified gender gap and ensuring equitable access to PA education are also important considerations. By equipping future agricultural professionals with the necessary knowledge and skills in PA, increased efficiency, sustainability, and productivity can be achieved within the Palestinian agricultural sector.

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