

Identifying and Content-Validating Key Determinants of Students' Interest in Agriculture: A PRISMA Review and Fuzzy Delphi Approach

Pengenalpastian dan Pengesahan Kesahan Kandungan terhadap Penentu Utama Minat Pelajar dalam Pertanian: Tinjauan Sistematis Berpandukan PRISMA dan Pendekatan Fuzzy Delphi

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ABSTRACT - This study aims to develop and validate instruments to measure the factors influencing students' interest in agriculture. Although the agricultural sector plays a significant role in the national economy, declining student interest in the field has become increasingly evident. Prior research indicates that perception and attitude, social and family influences, education and training, as well as economic and financial factors shape students' inclination toward agricultural careers. However, a comprehensive instrument systematically measures these factors has been lacking. To address this gap, the study developed an initial pool of 33 items using the PRISMA approach and subsequently validated them through the Fuzzy Delphi Method (FDM). A total of 10 experts in agricultural education evaluated the items. The FDM analysis applied three validation criteria: (i) a threshold value d below 0.2, (ii) expert consensus exceeding 75%, and (iii) fuzzy score values surpassing the α -cut level of 0.5. All 33 items met these criteria and were therefore retained. The validated instrument provides a structured measurement tool that can support future research and educational planning related to students' interest in agriculture.

ABSTRAK - Kajian ini bertujuan untuk membangunkan dan mengesahkan instrumen bagi mengukur faktor-faktor yang mempengaruhi minat pelajar dalam bidang pertanian. Walaupun sektor pertanian memainkan peranan penting dalam ekonomi negara, penurunan minat pelajar terhadap bidang ini semakin ketara. Kajian terdahulu menunjukkan bahawa persepsi dan sikap, pengaruh sosial dan keluarga, pendidikan dan latihan, serta faktor ekonomi dan kewangan membentuk kecenderungan pelajar terhadap kerjaya dalam pertanian. Walau bagaimanapun, masih tiada instrumen komprehensif yang mengukur faktor-faktor ini secara sistematis. Bagi mengisi jurang tersebut, kajian ini membangunkan kumpulan awal sebanyak 33 item menggunakan pendekatan PRISMA dan seterusnya mengesahkannya melalui Kaedah Fuzzy Delphi (FDM). Seramai 10 orang pakar dalam bidang pendidikan pertanian telah terlibat dalam penilaian item. Analisis FDM menggunakan tiga kriteria pengesahan, iaitu: (i) nilai ambang d kurang daripada 0.2, (ii) tahap kesepakatan pakar melebihi 75%, dan (iii) nilai skor fuzzy melepasi aras α -cut 0.5. Kesemua 33 item memenuhi kriteria yang

ditetapkan dan dikekalkan. Instrumen yang telah disahkan ini menyediakan alat pengukuran berstruktur yang boleh menyokong penyelidikan masa hadapan serta perancangan pendidikan berkaitan minat pelajar dalam bidang pertanian.

INTRODUCTION

The agriculture sector is a strategically vital element of Malaysia's economy, contributing RM25.7 billion or 6.3% to the national Gross Domestic Product (GDP) in 2023. This sector includes various essential subsectors, including crops, livestock, and fisheries, all of which contribute to national food security and rural livelihoods. In 2021, the agricultural sector employed 15.06 million individuals, with 63.6% being Malaysian residents. Apart from its economic impact, agriculture is crucial in enhancing national food systems, promoting community welfare, and fostering long-term economic resilience. Notwithstanding its significance, enthusiasm among youth for agricultural courses and professions persists in diminishing. Recent estimates reveal that graduates from agriculture-related disciplines constituted merely 1.5% of total graduates across 10 prominent fields of study in 2022, while enrollment in agricultural and veterinary programs decreased from 3,750 in 2021 to 3,452 in 2022. This ongoing decline highlights the necessity of comprehending the fundamental factors influencing students' interest in agriculture, especially as enhancing the agricultural workforce is vital for maintaining national food security and tackling future sustainability issues.

Current work delineates various aspects affecting students' interest in agriculture, encompassing perceptions and attitudes, familial and societal influences, educational experiences, and economic considerations (Rashid et al., 2020). Nonetheless, investigations in this domain are limited by the absence of scientifically proven and theoretically sound instruments. Knekta et al. (2020) assert that assessing student interest necessitates assessment instruments grounded in a definitive theoretical framework, as interest is a multifaceted concept encompassing emotive, cognitive, and value-related elements. This study conceptualizes "interest" through a multidimensional framework, corresponding to the designated domains: perception and attitude (affective), social and family (social-cognitive), education and training (experiential/cognitive), and economy and finance (value-based/expectancy considerations).

Numerous studies seek to investigate the drivers of agricultural interest; however, many utilize ad-hoc or inadequately validated questionnaires, which constrain their reliability, cross-context applicability, and utility for guiding educational initiatives (Yuliani, 2021). Furthermore, tools frequently neglect to encompass contextual subtleties pertinent to Malaysia's agricultural environment, including shifting socioeconomic anticipations, transforming labor market dynamics, and nascent technological advancements within the sector. Thus, a distinct need exists for a thorough, contextually aware, and theoretically grounded tool that can systematically assess the elements influencing students' interest in agriculture. Creating such an instrument is crucial for facilitating rigorous empirical research and for guiding evidence-based curriculum development, outreach programs, and strategic educational planning to enhance youth participation in agriculture.

1.2 Problem Statement

Agriculture is an essential sector for national growth, contributing to the economy, ensuring food security, and generating employment. Recent national higher education statistics reveal a persistent decrease in student participation in agriculture-related programs, prompting worries regarding the sustainability of the future workforce and the sector's ability to sustain national food systems and long-term economic resilience. Comprehending the factors influencing students' interest in agriculture necessitates measurement instruments that are theoretically sound and experimentally substantiated. Previous studies recognize several external factors—such as familial expectations, peer standards, society views, socioeconomic factors, and expected employment conditions—as significant predictors of students' schooling decisions (Rashid et al., 2020). Moreover, student interest is recognized as a multifaceted concept that includes emotive, cognitive, and value-related elements, necessitating assessment using theoretically grounded measurement frameworks (Knekta et al., 2020). Previous research investigating factors influencing agricultural interest have often been hindered by inadequate validation methods and insufficient contextualization, leading to fragmented and inconsistent findings in the literature (Yuliani, 2021).

A thorough literature study was performed utilizing scholarly resources such as Scopus, Web of Science (WoS), ERIC, and Google Scholar to solve these deficiencies. Boolean search words, including “student interest AND agriculture AND factors,” “agricultural education AND perception OR attitude,” and “youth AND agriculture AND career choice,” were utilized from January to March 2024, adhering to established inclusion and exclusion criteria. This PRISMA-guided review found four primary dimensions affecting students' interest in agriculture: perception and attitude, social and familial influences, education and training, and economic factors. These areas correspond with empirical findings highlighting that youth interest in agriculture is influenced by views about the sector, projected career prospects, and sociocultural expectations (Ridzuan et al., 2022). The four domains were subsequently aligned with the creation of a 33-item instrument, where each item corresponds to a construct derived from theoretical and empirical foundations. Experts in agriculture education subsequently performed content assessment to guarantee conceptual congruence, clarity, and contextual relevance. The validated instrument offers a systematic, evidence-based framework for evaluating students' interest in agricultural studies and enhances empirical research and educational planning to rejuvenate youth involvement in the agricultural sector.

1.2 Objectives and Research

This study aims to develop and validate an instrument to measure factors influencing students' interest in agriculture. Therefore, the objectives of this study are:

1. Determine the factors that influence students' interest in continuing their studies in the field of agriculture.
2. Develop an instrument to measure the factors that influence students' interest in agriculture.
3. Validate an instrument to measure factors that influence students' interest in agriculture

This study also emphasizes the following research questions:

1. What factors influence students' interest in agricultural education?
2. What instruments are developed to measure the factors influencing students' interest in agriculture?
3. To what extent do the items in the developed instrument get agreement among experts?

METHODOLOGY

2.1 Research Design

This study uses a developmental research design with quantitative methods. Three phases were implemented. The first phase employed the PRISMA technique to identify factors influencing students' interest in pursuing studies in agriculture. The second phase involved developing an instrument to measure these factors. The third phase focused specifically on validating the instrument's content using the Fuzzy Delphi Method (FDM).

2.2 Population and Sample

The population of this study consists of experts in Agricultural Education, including department heads, lecturers, trainers, and teachers who are directly involved in teaching agriculture. Eligible experts must be affiliated with higher education or training institutions offering agricultural programmes, such as public universities, private higher education institutions, vocational colleges, and agricultural skills training institutes under the Ministry of Agriculture and Food Security (ILKAP KPKM).

To identify the factors influencing students' interest in agriculture, articles will be screened from three databases—ResearchGate, MDPI, and Taylor & Francis Online—due to their relevance and extensive coverage of agricultural education literature. Expert selection for the FDM phase uses purposive sampling (Yusuf et al., 2023). A minimum of 10 experts is recommended to ensure sufficient uniformity and consensus in FDM studies (Yusoff et al., 2021). Therefore, 10 experts will be selected for this study. All experts must meet the criteria suggested by Mardi & Osman (2022):

- (i) possess at least a master's degree, and
- (ii) have a minimum of five years of experience in the field of agricultural education.

Experts will evaluate the relevance, clarity, and sufficiency of the instrument items. A language specialist will review the wording and suggest improvements to enhance clarity. Feedback from experts will be used to refine the research items accordingly.

2.3 Development of Instrument

A total of 32 items (8 items for each factor) will be developed based on literature review. This number ensures that even if certain items do not meet FDM acceptance criteria, enough valid items will remain (Yin & Hanif, 2024). The instrument uses a 5-point Likert scale ranging from “Strongly Disagree” to “Strongly Agree.” A five-point scale is widely recommended because it reduces respondent fatigue, increases response quality, and improves response rates (Sheetal & Harsh, 2004).

Experts will assess each item using the Likert scale and may provide additional comments in the space provided. Likert-scale data will be analyzed using Fudelo software, which is commonly used for FDM analyses. Before administration, the questionnaire will undergo content validation by expert reviewers to ensure relevance, accuracy, and alignment with research objectives. Ethical considerations include obtaining informed consent from experts, ensuring voluntary participation, and maintaining confidentiality throughout the data collection process.

Table 1. Validity panel information

Expert	Position	Aim of validation
1	Lecturer at public higher education institutes	Questionnaire content
2	Language study lecturer at public higher education institutes	Language use for questionnaire items

2.4 Data Analysis

The data analysis in this study was performed using three systematic techniques corresponding to the successive phases of the research. The PRISMA procedure was utilized to find, screen, and choose pertinent material, facilitating the categorization of elements affecting students' interest in agriculture. This procedure guaranteed transparency and rigor in identifying the theme structures to be incorporated into the instrument. The prepared instrument was subjected to content validation by subject-matter experts and a language specialist, who assessed each item for clarity, relevance, and appropriateness, resulting in revision based on expert feedback. The Fuzzy Delphi Method (FDM) was employed to evaluate expert consensus for the instrument items. Expert evaluations on a five-point Likert scale were analyzed using Fudelo software, which computed the Fuzzy Index, threshold values, and levels of expert consensus to ascertain the approval or rejection of each item. The investigations yielded a validated and reliable collection of questions that represent the principal determinants affecting students' interest in agriculture.

RESULTS AND DISCUSSION

The purpose of this analysis is to identify factors that influence students' interest in agriculture, develop instruments and validate instruments to measure factors that influence students' interest in agriculture.

3.1 Determination of Factors Affecting Students' Interest in the Field of Agriculture

The determination of factors influencing students' interest in agriculture began with a systematic literature review using the PRISMA framework, which provides a structured and transparent method for reporting review aims, procedures, and findings (Page et al., 2021). PRISMA's structured screening approach is recognized for enhancing the credibility and reproducibility of evidence selection (Trifu et al., 2022). The review process involved two stages: abstract screening, which yielded 36 relevant studies, followed by full-text evaluation, resulting in 26 studies retained for analysis. These studies were sourced from three databases—ResearchGate, MDPI, and Taylor & Francis Online—chosen for their extensive contributions to agricultural education literature, though this selection may have excluded relevant works from other repositories. The extracted factors were classified into eight categories:

education and training, perception and attitude, social and family, economy and finance, interest and motivation, experience and skills, infrastructure and support, and gender. Consistent with prior theoretical frameworks in vocational and agricultural education, these domains reflect influences identified in social cognitive career theory and human capital theory, both of which emphasize psychosocial and economic determinants of educational choices. From these, four dominant factors—education and training, perception and attitude, social and family, and economy and finance—were selected for instrument development. While these classifications ensured content relevance, further empirical testing is needed to determine their predictive influence on students' actual interest in agriculture.

Table 2. Summary of 8 Factors Affecting Interest in Agriculture

C o d e	Researcher	Education and Training	Perception and Attitude	Family and social	Economics and Finance	Interest and Motivation	Experience and Skills	Infrastructure and Support	Gender
p1	Obayelu & Fadele (2019)	✓		✓			✓		
p2	Parmar (2019)		✓	✓			✓	✓	
p3	Chipfupa & Tagwi (2021)		✓				✓		
p4	Ehien (2020)	✓		✓			✓		
p5	Uikey & Chinchmalatpure (2021)	✓	✓	✓			✓	✓	
p6	Nisa Suriani et al. (2023)		✓	✓					
p7	Plana-Farran & Gallizo (2021)			✓					
p8	Zidana et al. (2020)	✓		✓	✓		✓	✓	
p9	Singh & Misra (2021)	✓				✓			
p10	Alrawashdeh et al. (2023)					✓			
p11	Cosby et al. (2024)	✓	✓	✓		✓		✓	
p12	Rahman et al. (2023)		✓	✓	✓				
p13	Olowofeso (2021)	✓	✓	✓	✓				
p14	Inegbedion & Islam (2020)	✓		✓			✓	✓	

Continued

p15	Magagula & Tsvakirai (2020)	✓			✓				
p16	Ifeanyi-obi & Ewurum (2019)		✓	✓		✓		✓	
p17	Graham (2021)	✓							
p18	Dahalan et al. (2021)							✓	
p19	Zaremohzza bieh et al. (2022)	✓	✓	✓	✓	✓			
p20	Flannery et al. (2024)		✓	✓					✓
p21	Prasetyanin grum et al. (2022)		✓	✓	✓				
p22	Rahman et al. (2023)		✓	✓					
p23	Henning et al. (2022)	✓					✓		
p24	Rasak et al. (2023)	✓		✓					✓
p25	Rashid et al. (2020)	✓		✓					
p26	Ng'atigwa et al. (2020)	✓	✓				✓		
Frecuency		15	9	14	10	8	5	8	4

3.2 Development of an Instrument to Measure Factors Affecting Students' Interest in the Field of Agriculture

Based on the four dominant factors, an instrument comprising 32 items (eight per factor) was developed to operationalize key constructs identified during the literature review. Items were written to reflect themes repeatedly highlighted across the screened studies, thereby aligning with the theoretical and empirical foundations of agricultural education research. The instrument utilized a five-point Likert scale, which is widely recommended due to its ability to reduce respondent burden while enhancing response quality (Sheetal & Harsh, 2004). Preliminary content and language review was conducted by three experts from higher education and language education, consistent with best practices in instrument development. Expert selection followed purposive sampling recommendations (Yusuf et al., 2023), and the criteria applied were aligned with Mardi and Osman's (2022) guidelines requiring a minimum of a master's degree and at least five years of relevant experience. Although these reviews improved clarity and content alignment, the absence of a pilot study limits the ability to determine how students might interpret and respond to the items. Additionally, the reliance on experts primarily from higher education institutions may not fully capture the perspectives of agricultural practitioners or school-based educators. Thus, while the instrument demonstrates initial content coherence, further field-based validation is essential for confirming its psychometric robustness.

Table 3. Review Validity Panel Comments

Item	Expert Recommendations
I feel that agriculture is important for the development of the country.	I feel that agriculture is important for the economic development of the country.
I have a positive view of the future of the agricultural sector.	view the agricultural sector has a bright future to develop the national economy

Continued

Continued

I believe that agriculture is not just an activity of tilling the soil and raising animals	I believe that agriculture not only involves crops, but also animals (livestock) and fish (aquaculture)
I see agriculture as an innovative and modern field.	Need to make 2 items: 1. I see agriculture as an innovative field, where new technologies and approaches are constantly being introduced. 2. I see agriculture as a modern field, with the use of the latest equipment and methods
I want to know more about new technologies in agriculture	I follow the development of new technologies and innovations in agriculture
My friends have a positive view of a career in agriculture.	My friends think that a career in agriculture offers varied and flexible job opportunities
I have family members involved in agriculture.	My family members' involvement in agriculture influenced my view of the industry
The community around me appreciates the contribution of the agricultural sector.	The community around me appreciates the contribution of the agricultural sector
I often discuss agriculture with my peers	I often discuss agricultural issues with my peers to get more information about the sector
My parents understand the importance of education in agriculture	Parents apply agricultural knowledge in the family since childhood
I am interested in attending a workshop or seminar on modern agriculture.	I am interested in attending a workshop or seminar on innovation in agriculture
I want to have enough knowledge about agriculture	I always want to improve my theoretical and technical knowledge in agriculture
I am interested in the potential of using technology to improve agricultural yields.	I am interested in the potential use of agricultural technology that increases profitability and productivity
I am interested in exploring export opportunities in the agricultural sector.	I am interested in exploring export opportunities in marketing agricultural products
I believe agriculture can improve my standard of living.	I believe that agriculture can improve the economic status of me and my family.
I believe there are many job opportunities in the agricultural industry.	A career in agriculture promises long-term opportunities
I believe that there is financial support (such as grants or loans) for young entrepreneurs in agriculture.	Financial support was important in my decision to venture into agriculture

The construction of the items given to the experts is stated in Table 4. The expert's opinion on the items that have been developed to measure the factors affecting students' interest in the field of agriculture based on the 4 factors stated in Part B. Each item has been improved according to the views of language validity experts and experts in the field of agricultural education.

Table 4 Questionnaire Items and Elements Part B

Item	Element
B1 I believe the field of agriculture offers interesting career opportunities.	
B2 I think that agriculture is a field that can generate money.	
B3 I consider agriculture as a stable career for my future.	
B4 I feel that agriculture is important for the economic development of the country	
B5 I believe the agricultural sector has a bright future to develop the national economy.	
B6 I believe that agriculture not only involves crops, but also animals (livestock) and fish (aquaculture).	Perception and Attitude

Continued

B7	I see agriculture as an innovative field, where new technologies and approaches are constantly being introduced	
B8	I see agriculture as a modern field, with the use of the latest equipment and methods.	
B9	I follow the development of new technologies and innovations in agriculture	
B10	My family encouraged me to go into agriculture.	
B11	My friends think that a career in agriculture offers varied and flexible job opportunities	
B12	My family members' involvement in agriculture influenced my view of the industry	Social and family influences
B13	The community around me appreciates the contribution of the agricultural sector.	
B14	My teachers promote careers in the agricultural sector	
B15	I often discuss agricultural issues with my peers to get more information about the sector	
B16	I have idols in agriculture that I admire.	
B17	Parents apply agricultural knowledge in the family since childhood	
B18	I am interested in following a course or program related to agriculture	
B19	I have been involved in co-curricular activities related to agriculture at school	
B20	I often look for information about the latest technology and innovations in agriculture.	
B21	I am interested in attending a workshop or seminar on innovation in agriculture.	Education and Training
B22	I believe formal education in agriculture is essential for success in this sector.	
B23	I have the opportunity to gain practical knowledge in agriculture	
B24	I have been involved in agricultural projects at school or in the community	
B25	I always want to improve my theoretical and technical knowledge in agriculture	
B26	I believe the agricultural sector offers a profitable business opportunity	
B27	I think a career in agriculture promises a stable income	
B28	I am interested in the potential use of agricultural technology that increases profitability and productivity	
B29	I am interested in exploring export opportunities in marketing agricultural products	Economics and finance
B30	I believe the agricultural sector offers a wide range of career options with good financial prospects.	
B31	I believe that agriculture can improve the economic status of me and my family	
B32	A career in agriculture promises long-term opportunities.	
B33	Financial support was important in my decision to venture into agriculture	

3.3 Validation of Instruments for Measuring Factors Affecting Students' Interest in the Field of Agriculture

The instrument was validated using the Fuzzy Delphi Method (FDM), which synthesizes expert judgments to establish consensus on item relevance. Ten experts were selected through purposive sampling (Yusuf et al., 2023), consistent with recommendations that a minimum of ten experts improves consensus stability in FDM studies (Yusoff et al., 2021). Prior to analysis, three acceptance rules were established: a threshold value (d) ≤ 0.2 , expert consensus $\geq 75\%$, and a fuzzy α -cut value ≥ 0.5 . These decision rules reflect standard procedures in recent FDM applications, including those in education and technical training (Yin & Hanif, 2024). The analysis, conducted using Fudelo software, confirmed that all 32 items met the criteria, indicating high expert agreement with theoretical constructions and literature-derived domains. Despite this, it is important to emphasize that FDM establishes content validity, not the instrument's effectiveness or its statistical reliability in real-world contexts. Additionally, the expert panel, though qualified based on established criteria (Mardi & Osman, 2022), may not

represent the full spectrum of stakeholders in agricultural education. The absence of pilot testing also limits insight into item readability, respondent interpretation, or factor structure. Consequently, while FDM results support the conceptual appropriateness of the items, further empirical validation—such as exploratory and confirmatory factor analysis—is necessary before the instrument can be considered ready for widespread application

Table 5. Questionnaire Items and Elements

Item	Fuzzy Number Triangulation		Defuzzification process	Expert consensus
	Threshold value (d)	Expert consensus percentage (%)	Fuzzy score	
B1	0.0485	100%	0.74	Accepted
B2	0.0485	100%	0.74	Accepted
B3	0.05543	100%	0.72	Accepted
B4	0.0000	100%	0.80	Accepted
B5	0.02079	100%	0.78	Accepted
B6	0.0000	100%	0.8	Accepted
B7	0.0000	100%	0.8	Accepted
B8	0.02079	100%	0.78	Accepted
B9	0.06466	100%	0.66	Accepted
B10	0.06928	100%	0.68	Accepted
B11	0.06928	100%	0.68	Accepted
B12	0.06466	100%	0.66	Accepted
B13	0.05543	100%	0.72	Accepted
B14	0.097	90%	0.66	Accepted
B15	0.06929	100%	0.7	Accepted
B16	0.09353	90%	0.57	Accepted
B17	0.0739	100%	0.64	Accepted
B18	0.06928	100%	0.68	Accepted
B19	0.09815	90%	0.51	Accepted
B20	0.0485	100%	0.66	Accepted
B21	0.03695	100%	0.76	Accepted
B22	0.02079	100%	0.78	Accepted
B23	0.06466	100%	0.72	Accepted
B24	0.09699	90%	0.68	Accepted
B25	0.0485	100%	0.74	Accepted
B26	0.0485	100%	0.74	Accepted
B27	0.05774	100%	0.7	Accepted
B28	0.0485	100%	0.74	Accepted
B29	0.05774	100%	0.7	Accepted
B30	0.05543	100%	0.72	Accepted
B31	0.06466	100%	0.72	Accepted
B32	0.05543	100%	0.72	Accepted
B33	0.05542	100%	0.74	Accepted

The data obtained from expert evaluation was analyzed using a fuzzy approach. Each rating is extracted into a fuzzy number and then the fuzzy score percentage is calculated for each item. The average value of this fuzzy score is then used to determine the position (ranking) of each item in the instrument

measuring the factors influencing students' interest in agriculture. Table 6 shows the average value of the fuzzy score that has been ranked (Ranking) based on expert consensus.

Table 6. The Average Value of the Fuzzy Score

Position	Element	Average Fuzzy Score	Item
1		0.80	B4
2	Perception and Attitude	0.80	B6
3		0.80	B7
4		0.78	B5
5		0.78	B8
6		0.74	B1
7		0.74	B2
8		0.72	B3
9		0.66	B9
10		Social and family influences	0.72
11	0.70		B15
12	0.68		B10
13	0.68		B11
14	0.66		B12
15	0.66		B14
16	0.64		B17
17	0.57		B16
18	Education and Training	0.78	B22
19		0.76	B21
20		0.74	B25
21		0.72	B23
22		0.68	B18
23		0.68	B24
24		0.66	B20
25		0.51	B19
26	Economics and finance	0.74	B26
27		0.74	B28
28		0.74	B33
29		0.72	B30
30		0.72	B31
31		0.72	B32
32		0.70	B27
33	0.70	B29	

CONCLUSION AND RECOMMENDATIONS

In conclusion, the instrument that has been produced has a high level of agreement among experts. All 33 items were accepted to measure the factors affecting students' interest in agriculture. This instrument also provides useful guidance to educators and policy makers in planning more effective strategies to increase students' interest in this sector.

Agricultural education needs to be strengthened through a more interesting and relevant curriculum, with activities such as farm visits, industrial training, and exposure to modern technology in the agricultural sector. In addition, the promotion of the agricultural sector as a promising career needs to

be intensified, by highlighting job opportunities, broad career prospects, as well as its role in guaranteeing food security and the country's economic development. The instrument developed through this study is proposed to be widely used by counseling teachers and educators to identify students' interest in the field of agriculture, in addition to being further improved through further research. Strategic collaboration between educational institutions and the agricultural industry is also proposed to provide work-based learning opportunities, practical training, and mentoring programs. Policy support and incentives from the government such as scholarships, easy loans, and financial aid can help reduce the economic barriers that often stand in the way of student interest. Awareness campaigns to change the public's perception of agriculture as a modern, high-tech, and innovative sector also need to be intensified. Finally, further research is suggested to evaluate the effectiveness of this instrument in various contexts and identify other factors that may influence students' interest in agriculture. These measures are expected to increase the involvement of students in the field of agriculture, further supporting the development of this sector.

In the future, it is recommended that similar studies be carried out in a wider context involving a population of students with a more diverse background, such as students in primary, secondary, and skill training institutions. This can help understand the variation of factors that influence students' interest in agriculture at various levels of education. In addition, this study can also be developed by exploring additional factors that have not been touched upon in this study, such as the influence of modern technology, the learning environment, and the impact of globalization on student interest. Further studies can also evaluate the effectiveness of the instrument developed in a real context, such as its use by counseling teachers or educational institutions to identify students' interest in agriculture. This evaluation can help ensure the reliability and accuracy of the instrument and suggest improvements to increase its effectiveness. Additionally, studies can focus on specific interventions, such as career awareness programs or direct exposure to the agricultural sector and evaluate how those interventions affect student interest. Further research is also recommended to establish collaboration with the industrial agriculture sector to understand the real needs of the job market. With this, the instruments developed can be adapted to be more relevant to the challenges and opportunities in the agricultural sector. Finally, a longitudinal approach can be considered to study changes in students' interest in agriculture over time, as well as the factors that contribute to those changes. These recommendations are expected to enrich the current research findings and contribute to the development of a more sustainable agricultural sector.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHORS' CONTRIBUTION

The authors confirm contribution to the paper as follows: Suhaizal Hashim: Literature review, methodology, data collection and project administration. Muhammad Iqbal Afiq Muhammad: Drafted the manuscript and provided substantial revisions formal analysis, and validation. Khairul Anuar Abdul Rahman: Contributed to writing the results and discussion sections, conceptualization, methodology and resources. Nurul Nadwa Zulkifli: Conceptualization, methodology and resources.

AVAILABILITY OF DATA AND MATERIALS

Please choose one of the applicable statements below.

1. Data available within the article or its supplementary materials.
2. Data available on request from the authors.
3. Data is openly available in a public repository, with a permanent identifier (such as a DOI).
4. Data embargoed due to commercial restrictions.
5. Data available on request due to privacy/ethical restrictions.
6. Data generated at a central, large-scale facility, available upon request.
7. Data subject to third-party restrictions.

DECLARATION OF GENERATIVE AI

During the preparation of this manuscript, the authors' used ChatGPT and Gemini to improve the language flow and enhance the readability of the text. After using this tool/service, the authors reviewed and edited the content as needed and takes full responsibility for the content of the published article.

ETHIC STATEMENTS

Not applicable in this section.

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