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Sustainable Agriculture: Relationship between Knowledge and Attitude among University Students

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Abstract: Sustainable agriculture (SA) has emerged as an alternative to feeding an increasing global population. Several frameworks have been used in SA research. This study proposes understanding SA under five components: environment, economy, society, resilience, and persistence. The decision-making process for adopting SA is determined by several factors, such as knowledge and attitudes. Both constructs play a decisive role in SA's development, a field where university students are called to be leaders and decision-makers. Despite the increase in the body of SA literature, little is known about SA in Latin America. This research aimed to analyze university students' attitudes and knowledge of SA and the relationship between both constructs. A completely structured questionnaire was designed and distributed online. A Likert-type scale was used for attitude and multiple-choice questions for knowledge. It was found that, among participants (n = 374), the majority had a high level of attitude (71.9%) and a moderate level of knowledge (62.1%) of SA. Participants' attitudes towards SA were positive, regardless of gender (p = 0.17) and perceived knowledge does not predict measured knowledge (R^2 = 0.074; $p < 0.001$). Moreover, a low positive relationship was found between attitude and knowledge (r_s = 0.252; p = 0.000). Further research should focus on analyzing other factors that could affect attitude and knowledge of SA.

Keywords: agricultural sustainability; sustainable farming; college education; agricultural education; resilience

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1. Introduction

A growing global population has led to environmental depletion [1]. On the other hand, people worldwide depend on agriculture as an essential source of basic needs for human survival [2]. The increase in agricultural productivity within the last 50 years has depended on fertilizers, irrigation, machinery, pesticides, and land use [3]. However, expecting these relationships to remain linear in the future might be too optimistic [3]. For example, the indiscriminate use of synthetic fertilizers intends to supply enough food, but instead, it negatively impacts the environment and living beings that inhabit it [1,4–6].

The damaging impact of agriculture on the environment has been documented extensively in several ways, e.g., soil use change, greenhouse gas emissions, excessive water use, and biodiversity disturbance affectation [7–9]. Some authors suggest increases between 60 and 100% in production to satisfy food demand for 2050 [10,11]. However, some projections overestimate yield growth due to misinterpreting the underlying assets projections and ignoring recent productivity improvements [12]. Additionally, these are commonly simplified into a single goal of doubling production, which implies an urgent need for research, policies, and industry [11,13–15]. This simplification of objectives could aggravate the environmental challenges by promoting agrochemical use [12]. Therefore, it is critical to seek new effective strategies to increase food production in the future [16,17]. Furthermore, there is a growing pressure to produce more food, so it is essential to do it sustainably [9,12,18]. Weiner highlights that SA is one of humanity's biggest challenges [19].

Sustainability has become overused and a buzzword, often misused, to promote specific interests [19]. Thus, it is necessary to seek new approaches that: (1) involve biological and ecological processes in the food chain; (2) minimize the use of non-renewable inputs; (3) make productive use of farmer's knowledge; and (4) take advantage of people's collective capacities to work together in resolving agricultural and environmental challenges related to pests, watersheds, and forests [3]. Nevertheless, the lack of urgency and quantitative objectives related to SA has resulted in an imbalance between conservation and production [12].

Sustainable agriculture is a complex and challenging term to define [20–22] because each agricultural impact occurs differently, and the synergy between its constituents is unclear [18]. Interest in the sustainability of farming and production systems began its development around the 1950s, even though there are records of its principles dating back to ancient Chinese, Greek, and Roman writings [3]. Now the interest is more focused on the need for developing agricultural technologies and practices that (1) do not have undesired effects on the environment; (2) are accessible and efficient for farmers; (3) improve food productivity; and (4) have positive effects on environmental goods and services. Additionally, sustainability in agricultural systems involves concepts of resilience (i.e., a system's capacity to buffer impacts and stresses) and persistence (i.e., a system's capability to continue over long periods), and also considers the effects on the economic, social, and environmental domains [3,23]. The study of each component is part of different research fields, each with its ideology and vocabulary [23].

Adopting SA has several long and short-term benefits [24]. However, the decision-making process of adopting SA is swayed by various factors, including knowledge [24] and attitudes [25]. That is why people's knowledge and attitudes play a decisive role in SA [26,27]. Understanding the relationship between different aspects of sustainability can be helpful in two ways: to help farmers understand the limitations in implementation, as well as the potential for win–win solutions, and to balance efficiency and quality when developing or applying sustainability evaluation methodologies [18].

Knowledge is defined as the understanding of information and the cognizant perception of significance [28]. Knowledge can contribute to this process by providing learning opportunities [21]. Moreover, knowledge and education are considered to be factors that help reduce other perceived barriers regarding SA [24]. Throughout the literature, knowledge is measured differently and often assessed as perceived knowledge. Self-perceived knowledge is susceptible to psychological factors, and results are likely to be skewed [29]. Although different constructs, both are crucial for adopting practices. There is an existing gap in SA research and the difference between perceived and actual knowledge. Improving farmers' knowledge and changing their beliefs about SA may change their attitudes [30].

Attitude is the willingness to answer favorably or unfavorably to an object, person, institution, or event [31,32]. It is based on cognitive beliefs toward an attitude object [26,31]. To form a positive attitude, farmers need enough knowledge and experience because this would allow them to understand concepts and change their attitudes [33]. Attitude and beliefs are expected to be the defining key in the management decisions that will be taken [8]. Furthermore, studies in alternative agricultural practices have explored gender-differentiated relationships on psychosocial constructs such as attitudes [26,34,35].

If we expect the scientific community to develop sustainable agricultural systems, this process must require the participation of researchers and farmers [8]. More studies that use a common framework to quantify the multifaceted impacts could help identify other possible solutions for each situation across different circumstances [23]. Additional investigations have attempted to quantify attitudes and knowledge of SA in various regions and target populations, with farmers as the majority. Nevertheless, this has been based on several reference frameworks for SA [8,9,18–22,24,26,28,30,33,36–44]. In the future, agricultural students may influence farmers' adoption of SA practices [45].

It Is necessary to reorganize agriculture education to equip agronomists with competencies that prepare them to advocate SA effectively [35]. Attitudes and knowledge are critical components of behavior change in SA practices [28]. In line with previous studies, this one focused on university students because they will become leaders and decision-makers in the future [46,47]. Therefore, students' attitudes and knowledge of SA are of keen interest. However, there is little research regarding education in SA [48] and determining students' understandings [45]. Moreover, there is a gap in SA education in Latin America. This study intends to contribute to this research stream via an instrument adjusted to the region's particularities.

The research question proposed was: is there a relationship between the attitude and knowledge of sustainable agriculture among Latin American students? In this context, the research objectives were: (1) to analyze students' attitudes towards SA and its association with gender; (2) to evaluate students' knowledge of SA and its relationship with perceived knowledge; and (3) to determine the relationship between knowledge of and attitude towards SA.

2. Materials and Methods

2.1. Study Population, Design and Sampling

This quantitative, non-experimental, and correlational study gathered data from 551 students from 21 countries at a Honduran agricultural university. The topic of SA is intentionally woven into students' coursework across academic disciplines throughout the university. Students are exposed to the principles of SA repeatedly over the course of their academic study. Participants' attitudes and knowledge were evaluated via a completely structured questionnaire that included seven demographic questions, 15 5-level Likert-type attitude statements, and 15 multiple-choice questions for knowledge. The sampling was non-probabilistic, with quotas calculated based on the number of students in each department and year. For that, a considerable percentage of participants was surveyed according to those demographics to represent the target population better. It is worth saying that we do not intend to generalize the results to the whole population of students with this sampling. Yamane's formula was used to calculate the sample size:

$$n = N/(1 + N \times e^2), \quad (1)$$

N: population size
e: precision level
n: sample size

The instrument was built based on the existing literature on SA and its five components: environmental, social, economic, resilience, and persistence [23]. Hence, two sections of 15 questions were grouped according to these components. The first section measured the participants' attitudes toward SA, and the second assessed their knowledge.

The research hypothesis was that a positive relationship exists between university students' knowledge and attitude toward SA. For this study, attitude was the dependent variable, and knowledge was the independent one. First, the instrument was validated by a panel of experts. Then, a pilot test with 40 participants was conducted to ensure the instruments' reliability. Once the instrument was tested, it was distributed and completed online in July 2020.

2.2. Statistical Analysis

After data cleaning, 374 responses were considered for the analysis. SPSS version 25 was used to analyze the data. First, a Cronbach's alpha test (α = 0.75) showed the acceptable interitem consistency for the attitude section [49], which had ordinal scale statements. Next, descriptive statistics were used to show participants' demographic characteristics, attitudes, and knowledge of SA. The significance level used for all inferential analyses was α = 0.05. Since the sample was not normally distributed, the tests were non-parametric. For objective one, a Mann–Whitney test was used to determine the association between attitude towards SA and gender. For objective two, a simple linear regression was used to measure the level of prediction of the measured knowledge from the perceived knowledge of SA. A scatterplot of perceived knowledge predicting assessed knowledge was prepared. Visual inspection indicated a linear relationship between the variables. Residuals were independent, as assessed by the Durbin–Watson statistic of 1.447. There was homoscedasticity, as assessed by visual inspection of a plot of standardized residuals versus standardized predicted values. Residuals were normally distributed as evaluated by visual inspection of a normal probability.

For objective three, individual scores were added to determine each component's score, and the negative statement's values were reversed. Attitude and knowledge totals were categorized into high, moderate, and low [46]. Next, a Chi-square test (linear-by-linear) was conducted to determine if the responses followed a theoretically expected distribution. A Spearman correlation test was then used to establish the association between attitude and knowledge of SA.

3. Results

3.1. Demographics

Most participants were men (54.3%), similar to the student population. Moreover, most of them were undergraduate students (96.5%). The mean age for undergraduates was 23 years (mean, median, and mode), and 29 for master students (mean 29, median 29, and mode 30).

3.2. Attitude towards Sustainable Agriculture

The first section aimed to measure students' attitudes toward sustainable agriculture. They were asked about their level of agreement with 15 statements via a 5-level Likert-type scale: strongly disagree (TD), disagree (D), neither agree nor disagree (N), agree (A), and strongly agree (TA) [46,50]. Negative statements were intentionally designed with two purposes: to verify participants' sincerity and to measure their level of agreement. The values for these items were reversed for further analysis. Table 1 shows the frequency and percentage for each item regarding attitude.

The results reveal that students who participated tend to have a positive attitude towards sustainable agriculture. Nine of the fifteen items showed more than 75% acceptance, and five received over 90%. Statements A5, A10, and A14 received the highest levels of agreement. Most participants agreed with the general well-being of field workers (96.0%), crop rotation benefits (93.8%), and product diversification to avoid monoculture dependence (92.0%).

Attitude toward crop rotation aligns with Sydorovych and Wossink's findings, where respondents' level of acceptance was 80% [22], but higher than Comer et al.'s study with 47.6% [38]. Crop rotation is an ancient agricultural practice with well-documented benefits for productivity and stability in agrarian settings [40]. Comer et al.'s research showed 42.9% acceptance of diversification in production [38]. It is worth mentioning that these investigations were performed in the United States and Uruguay, respectively.

On the other hand, without re-coding, the statements with higher levels of disagreement were A9 and A13. In A9, 13.6% of the participants felt that sustainable agriculture should focus only on subsistence rather than profitability. According to statement A13, 13.4% of the participants considered that sustainable agriculture does not have less risk of the impacts caused by natural phenomena. Although these statements presented higher levels of disagreement, these were not above 15% of the participants.

Finally, the items with higher levels of uncertainty were A7, A3, and A9. In a significant proportion (36.6%), participants were undecided about whether more agrochemicals should be used to increase farm yield. Moreover, about a fourth of the participants (23.8%) showed indecision regarding whether or not manure should be used because synthetic fertilizers are more efficient than organic. This resembles Hasan et al.'s report, where participants showed uncertainty about whether organic manure can be economically comparable to chemical fertilizers [42].

Table 1. Frequency and percentage of attitude towards sustainable agriculture items (*n* = 374).

Category/Statement	TD + D		N		A + TA	
	n	%	*n*	%	*n*	%
Environmental						
A1. Soil and water are the source of all life and should be used efficiently	36	(9.6)	1	(0.3)	337	(90.1)
A2. Biological control should be used because it is the best way to reduce pest and weed damage.	29	(7.7)	57	(15.2)	288	(77.1)
A3. Green manure should not be used because chemical fertilizers are more efficient.	259	(69.2)	89	(23.8)	26	(7.0)
Social						
A4. The indiscriminate use of agrochemicals should be reduced because it is harmful to human health	18	(4.8)	33	(8.8)	323	(86.4)
A5. Field workers' welfare should be considered, not just wages.	6	(1.6)	9	(2.4)	359	(96.0)
A6. There should be no difference between a worker's salary based on gender.	14	(3.7)	21	(5.6)	339	(90.7)
Economical						
A7. More agrochemicals should be used to increase farm productivity. [a]	207	(55.4)	137	(36.6)	30	(8.0)
A8. Crop energy efficiency should be pursued to reduce production costs.	7	(1.9)	34	(9.1)	333	(89.0)
A9. The profitability of the agricultural system should not be sought, but only subsistence. [a]	247	(66.1)	76	(20.3)	51	(13.6)
Persistence						
A10. Crop rotation should be used to reduce pests and maintain long-term soil health.	10	(2.7)	13	(3.5)	351	(93.8)
A11. Future generations should not be prioritized because current food demand is more important.[a]	36	(9.6)	58	(15.5)	280	(74.9)
A12. Monoculture should be avoided because its production is more vulnerable over time.	31	(8.3)	66	(17.6)	277	(74.1)
Resilience						
A13. Sustainable production should have less risk to the impacts of natural phenomena.	50	(13.4)	71	(19.0)	253	(67.6)
A14. Production should be diversified to avoid dependence on a single crop.	9	(2.4)	21	(5.6)	344	(92.0)
A15. Agricultural systems should have crop associations to adapt to climate change.	8	(2.1)	44	(11.8)	322	(86.1)

[a] Negative statement re-coded afterward.

Nevertheless, 86.2% of the participants considered that agrochemical use should be decreased due to its harm to human beings' health. Although attitudes towards agriculture, the environment, and society are associated with agrochemicals, other factors influence their use [30]. Beus and Dunlap's study found that agrochemical use was a controversial agricultural practice and still remains so [37]. Some participants (20.3%) were undecided about the economic role of sustainable agriculture and whether it should be to subsist or generate profits. This aligns with Comer et al.'s results, where only 8.6% considered it profitable [38]. According to Petrzelka et al.'s results, information availability regarding conventional agriculture is significantly related to the higher use of agrochemicals [30].

Each statement regarding attitude towards sustainable agriculture received a value between 1 (TD) and 5 (TA). Consequently, the value range is from 15 to 75. Results show a minimum of 35 (*n* = 1; 0.3%), and a maximum of 75 (*n* = 9; 2.4%). The mean for attitude was 62.73 (*SD* = 6.39; median and mode = 63). This is similar to Hameed and Sawicka's findings, whose mean was 68.32 (*SD* = 5.44) [41]. Finally, individual scores for attitude towards sustainable agriculture were classified by percentage as follows:

(a) Low attitude: values less than 60%;
(b) Moderate attitude: values within 60% and 80%;
(c) High attitude: values above 80%.

Table 2 shows the level of attitude towards sustainable agriculture among participants. The majority of them fall into the category of high attitude (*n* = 269; 71.9%), followed by moderate (*n* = 100; 26.8%), and low (*n* = 5; 1.3%). These results are similar to Liaghati et al.'s, whose percentages were 74.7%, 22.3%, and 3.0%, respectively [51].

Table 2. Level of attitude toward sustainable griculture (*n* = 374).

	Level	Frequency	Percent
Attitude	High	269	71.9
	Moderate	100	26.8
	Low	5	1.3

The Mann–Whitney test showed that attitude has no statistical association with gender ($p = 0.17$). It is possible that a positive attitude towards SA could be a characteristic that the university in the study has been seeking via the selection process for accepting students of both genders. These results contrast Karami and Mansoorabadi regarding the significant difference between farmers' attitudes towards SA, highlighting that women were more positive [26]. It is worth saying that this study was conducted with farmers in Iran.

3.3. Knowledge of Sustainable Agriculture

Participants' knowledge of SA was assessed via 15 questions. Table 3 describes the frequency and percentage for each of them. Each component (environmental, social, economic, resilience, and persistence) had three items. The results show that, in general, the participants know about sustainable agriculture, as most of them answered 13 out of 15 questions correctly. Seven received more than 80% of correct answers and four more than 90%. In addition, most participants were correct in K5, K1, and K12.

Table 3. Frequency and percentage of knowledge of sustainable agriculture items (*n* = 374).

Category/Statement	Correct		Incorrect	
	n	%	*n*	%
Environmental				
K1. An environmentally sustainable crop implies producing the amount the environment can support without negatively impacting the environment.	359	(96.0)	15	(4.0)
K2. A "crop" functions as an ecosystem.	254	(67.9)	120	(32.1)
K3. Conventional production affects soil biodiversity.	33	(88.5)	43	(11.5)
Social				
K4. A socially sustainable crop implies paying its workers a fair wage per their job responsibilities.	323	(86.4)	51	(13.6)
K5. People's well-being goes beyond economic income.	363	(97.1)	11	(2.9)
K6. Conventional agriculture does not allow small farmers to achieve food security.	201	(53.7)	173	(46.3)
Economical				
K7. An economically sustainable crop implies running a profitable business.	184	(49.2)	190	(50.8)
K8. Generally, the conventional farming system is more productive in a production cycle.	212	(56.7)	162	(43.3)
K9. Conventional production is more costly when externalities are taken into account.	229	(61.2)	145	(38.8)
Persistence				
K10. The key to future agriculture development lies in learning to mimic natural ecosystems and farm in harmony with nature.	342	(91.4)	32	(8.6)
K11. A sustainable agricultural system is more productive over time.	261	(69.8)	113	(30.2)
K12. The erosion of soil quality will affect the ability to produce food in the future.	350	(93.6)	24	(6.4)
Resilience				
K13. Resilience is the capacity of systems to withstand shocks and disturbances.	121	(32.4)	253	(67.6)
K14. Sustainable cultivation tends to be less impacted by an extreme natural event	309	(82.6)	65	(17.4)
K15. Sustainable cultivation better buffers the effects of climate change.	257	(68.7)	117	(31.3)

The human well-being beyond their income question (K5) had the highest correct answer (97.1%). Farmers' well-being, quality of life, equity, and participation are essential social criteria for sustainable agriculture [52]. The second highest correct answer was that an environmentally sustainable crop implies producing an amount that the environment can handle without generating a negative impact (96.0%). One of the primary purposes of sustainable agriculture is to create agricultural systems that mitigate or delete environmental threats associated with industrial agriculture [53]. Finally, soil quality depletion will affect food production capacity in the future (93.6%). In the research by Dogliotti et al. in Uruguay, farmers and scientists identified the loss of soil quality as a significant cause of unsustainability [40].

Many participants do not consider resilience as the capacity of the systems to buffer impacts and disturbances (67.6%), which is its definition according to Garibaldi et al. [23]. The resilience concept has evolved; nowadays, its definitions are diverse, which can be confusing [54]. Nevertheless, none are close to the most common answer among participants: "the system's capacity to return to the conditions previous to the impact" (n = 170; 45.5%). Moreover, 11% chose "the system capacity to recover from the impact," and 11.2% did not know. This reflects a misinterpretation of the current definition of resilience, suggesting that education regarding this concept should be addressed and reinforced in all years.

The majority was wrong about whether an economically sustainable crop is profitable (50.8%). According to Rezaei-Moghaddam and Karami's analysis, sustainable agriculture is not economically viable unless it is profitable, productive, and reduces unemployment [52]. It is not convenient that students ignore the importance of profitability for a system to be sustainable.

Each correct answer regarding knowledge of sustainable agriculture received a value of 1 and 0 for each incorrect answer. Therefore, the value range is 0 to 15. Results show a minimum of 3 (n = 1; 0.8%) and a maximum of 15 (n = 4; 1.1%). The mean for knowledge was 10.95 (SD = 2.13; median = 11 and mode = 12). Finally, individual scores for knowledge of sustainable agriculture were classified by percentage as follows:

(a) Low knowledge: values less than 60%;
(b) Moderate knowledge: values within 60% and 80%;
(c) High knowledge: values above 80%.

As shown in Table 4, the majority of students possess moderate knowledge of SA (n = 232; 62.1%), followed by high (n = 91; 24.3%), and low (n = 51; 13,6%). This contrasts with Asadi et al., where the results of knowledge were 71.2%, 26.2%, and 2.5% for high, moderate, and low, respectively [2]. However, their study measured perceived knowledge instead of assessed knowledge.

Table 4. Level of knowledge of sustainable agriculture (n = 374).

	Level	Frequency	Percent
Knowledge	High	91	24.3
	Moderate	232	62.1
	Low	51	13.6

An additional question about perceived knowledge of SA was asked, with values between 0 and 10. The minimum was 0 (n = 3; 0.8%) and the maximum 10 (n = 17; 4.5%). The mean was 6 (SD = 2.067), the median was 6, and the mode was 5. A simple linear regression was run to predict the assessed knowledge from the perceived one ($\beta = 0.271$, $t(372) = 5.429$, $p < 0.001$; ($F(1, 372) = 29.473$), $p < 0.001$, with an R^2 of 0.074; adj R^2= 0.071) Although significant, assessed knowledge only explains 7.4% of the variation in perceived knowledge. It is erroneous to assume that perceived knowledge of SA represents measured knowledge.

3.4. Relationship between Attitude towards and Knowledge of Sustainable Agriculture

The independence Chi-square test (linear-by-linear) was run to determine the relationship between knowledge and attitude toward sustainable agriculture (Table 5). It shows that participants with a moderate level of knowledge tend to have a high attitude ($\chi 2 = 25.568$; df = 1; p = 0.000). Moreover, the p-value reflects a significant relationship

($p < 0.05$). Previous research has found a positive relationship between knowledge and attitude towards SA [33,38].

Table 5. Chi-square test for independence between attitude and knowledge of sustainable agriculture ($n = 374$).

	Level	Knowledge				*p*-Value
		High	Moderate	Low	Total	
Attitude	High	80	163	26	269	< 0.001
	Moderate	11	67	22	100	
	Low	0	2	3	5	
	Total	91	232	51	374	

In the study by Evans and Durant, a significant positive correlation was found between knowledge and attitude [55]. Nevertheless, the authors suggest that it varies considerably depending on the components involved. A Spearman correlation was run between attitude and knowledge, and a low positive relationship was found ($r_s = 0.252$; $p = 0.000$). This is congruent with Azman et al.'s results, where a low positive relationship was found between knowledge of and attitude towards SA ($r = 0.215$) [33].

Recent literature on SA has contributed to the importance of psychosocial constructs in adopting or implementing its practice. A study conducted in Bangladesh found a positive relationship and interconnections between social, environmental, and economic indicators [56]. Another study in Kentucky, USA, found that lack of knowledge is a major and significant barrier to adopting SA practices and that adoption intensity is higher among farmers with higher education degrees [24]. Moreover, a study from Thailand concluded that attitudes toward SA and education are significant factors that influence sustainable farming practices [28]. On the other hand, a study with Vietnamese farmers found that attitude does not significantly influence the intention to adopt sustainable agricultural practices [25]. Nonetheless, the latter focused mainly on the environmental component of SA regarding climate change adaptation. Even though the body of literature on SA and the influence of psychosocial constructs continues to increase, studies usually focus on farmers.

4. Conclusions

SA research is broad among disciplines but usually focuses on farmers when considering psychosocial constructs (attitudes and knowledge). Nevertheless, it has been found that education is an essential factor in adopting SA practices. Although research on university students' attitudes and knowledge is not new, the focus on SA in the Latin American region is scant.

The key findings indicate that most students have a positive attitude towards SA, regardless of gender, and a moderate level of knowledge of SA. It was also found that perceived knowledge did not predict measured knowledge of SA. Finally, the relationship between attitude and knowledge of SA was found to be positive but low.

Improving university students' attitudes towards and knowledge of SA requires it to become a cross-cutting component in agricultural education. For instance, profitability, risk reduction, and resilience could be enhanced by including them in the curriculum and complementing them with action learning. More importantly, future research should address other factors that could influence the attitude and knowledge of SA (i.e., teachers' knowledge and attitude towards SA, environmental behavior, and educational approaches).

This study also has limitations. For instance, the results are not generalizable. Moreover, other unmeasured variables may affect how participants responded to the questions. The statistical analyses were chosen to answer the research objectives. However, due to the complexity of SA, more could be inferred from the data if further post-hoc analyses were considered. For instance, models that explain the interaction among constructs and components. Since data were collected during the COVID-19 pandemic, it could be something that influenced participants' responses. Nevertheless, they offer insight into university students' attitudes and knowledge of SA in Latin America. Moreover, it provides a guide for future research to use the questionnaire in different settings for validating the instrument application elsewhere and in a larger sample for generalizable results.

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