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Akin, Heather; Akinyemi, Babatope; McQuillan, Julia; and Brown-Brandl, Tami, "Students' Knowledge of and Attitudes Toward Dairy Production: A Survey Methodology Report" (2023). *Faculty Publications: Agricultural Leadership, Education & Communication Department*. 114. https://digitalcommons.unl.edu/aglecfacpub/114

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Students' Knowledge of and Attitudes Toward Dairy Production:

A Survey Methodology Report

June 2023

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Abstract

This report presents findings from a pilot survey conducted among undergraduate and graduate students (N = 410) at the University of Nebraska-Lincoln about students' perspectives on technology usage, consumption, and sustainability in dairy production systems. An interdisciplinary research team developed the survey instrument and report. The main purpose of this pilot study was to create and administer survey items to support further research on experiential education and outreach opportunities related to robotics in small-scale dairy production and rural economic development. Descriptive findings indicated that most students had some familiarity with dairy production and the nutritional aspects of dairy products but expressed a desire to learn more. The majority of participants agreed that "The sustainability of our food system is important to me personally." Among three statements about technology usage in dairy production, the statement "technology will improve the livelihoods of people working in agriculture" received the highest mean score, indicating that students largely agreed with this statement. Regarding animal welfare, students believed that caretakers should ensure the health of dairy cows. Many indicated that they think small dairy farms can be financially viable. Notably, most students agreed with the statement "I enjoy learning through immersive experiences (hands-on or virtual reality)." Half of the students expressed a high or moderate level of interest in agricultural-related careers, 80 percent showed a high or moderate interest in technology-related careers, and 82 percent demonstrated a high or moderate interest in careers in sustainability.

Keywords: small-scale dairy production, public engagement, consumer perceptions, agricultural technology, sustainability, animal welfare, rural development, immersive learning, higher education

Introduction

Innovative and effective agricultural practices are a valuable strategy to support a growing population considering the challenges posed by climate change, labor shortages, and supply chain disruptions (Díaz et al., 2019). The consolidation of animal food production over the last century has led to an increase in supply and a decrease in the cost of animal-based food products (MacDonald et al., 2020). However, these advancements come at significant risk to food security, animal well-being, environmental sustainability, risk of zoonotic disease, and the social fabric of rural communities (Rossi & Garner, 2014). These concerns have resulted in growing skepticism among the public regarding the quality and ethicality of consuming animal products (Barrett & Rose, 2022).

To understand current knowledge and attitudes towards one type of animal agriculture, dairy production, this report summarizes responses to a survey of students. The survey items collected self-reported consumption choices, views toward the sustainability of dairy, the use of technology in dairy production, and attitudes toward animal well-being in dairy production. The research was conducted by an interdisciplinary team of researchers who surveyed students in an introductory Sociology class, a freshman level and a senior level Biological Systems Engineering class, and students participating in an event for those interested in agriculture and natural resources. The survey assessed existing knowledge and attitudes with the goal of assessing the areas of greatest need for informal education, formal teaching, and public outreach materials on the topic of the use of robotics for small-scale dairy production, and the potential of such dairies to support economic development in local, rural economies. The pilot survey was developed with an interdisciplinary research team that aims to engage and provide experiential outreach

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activities for K-12 students and the public on topics related to dairy production and the future of animal agriculture.

The findings are intended to guide the creation of resources that will increase accurate knowledge of dairy nutrition, animal well-being practices, and the potential benefits of automation for economic, environmental, and societal sustainability. In addition, the survey responses will guide efforts to help young adults to see the potential for science, technology, engineering, and mathematics (STEM) careers in animal agriculture that also can support sustainability, technology, and agriculture.

Methods

Data were collected in April and May 2023 and administered via an online, anonymous survey. A convenience sample of students from the College of Agricultural Sciences and Natural Resources (CASNR) and a College of Arts and Sciences (CAS) Introductory Sociology course at the University of Nebraska completed surveys designed to assess the knowledge, attitudes, and experiences of students with a range of disciplinary interests and statuses (e.g., graduate, and undergraduate students) (N = 410). The convenience student sample provided pilot data to evaluate the survey items because many were designed by the team. We included students focused on agriculture and students not focused on agriculture to assess if the survey items were appropriate for both those closer to agriculture and those unlikely to have much experience with agriculture. Based on the distribution of responses and the correlation among the items, we will use the results to guide efforts to refine the survey for future use with a random sample of the population that will be generalizable.

The survey respondents who completed the survey on the CASNR campus were provided with the survey via the UNL-licensed version of Qualtrics (Appendix A) and the students in the introductory sociology course completed the survey via a Canvas quiz in exchange for extra credit (and were given an alternative extra credit assignment if it was requested). Respondents had to be students and 19 years of age or older to complete the survey and agreed to participate via an online, informed consent form on the first page of the survey. Respondents who were invited to participate at UNL's Dairy Store received the link to the survey via a QR code on a sticker (Appendix B) that they could keep. Visitors to the UNL Dairy Store were also able to view displays generated by a design course at UNL during the fall semester of 2022. A screening question asked whether respondents had viewed the displays, and if so, what their perceptions were in terms of how they depicted how the facility might work, their excitement about a robotic dairy on campus, the importance of a publicly accessible dairy on campus, and whether or not they would visit a dairy facility if there was one on campus.

Surveys were administered to different groups of students across the University of Nebraska-Lincoln campus. Students who visited UNL's Dairy Store during CASNR Days (an event for the College of Agricultural Sciences and Natural Resources community) on April 20, 2023, or, who were part of a class in either CASNR's or UNL's Department of Sociology were invited to complete the brief survey. The survey was distributed via a QR code on a sticker that participants could keep. The survey took 4-5 minutes to complete. Survey data were exported from Qualtrics and Canvas, merged, cleaned, and summarized using descriptive statistics (means, percentages, and correlations). The research team secured Institutional Review Board (IRB) approval for human subjects' research. There was some attrition of participants who completed the survey during UNL's CASNR Days, as participants likely completed the survey on their phones and did not receive an incentive for completing the survey. The final sample size was 410 participants.

Measures

The surveys included questions assessing respondents' perceptions and attitudes toward dairy products, the use of technology in dairy production, views toward sustainable agricultural production, and knowledge and familiarity with these topics. Respondents were also asked for demographic information including gender identity (41.4% male, 56.7% female; 1.8% non-binary or third gender) and student status (93.4% undergraduate students). Within the sample, 44.9% were from the College of Agricultural Sciences and Natural Resources (CASNR) and 55.1% were from introductory sociology courses. Questions were measured using Likert and Likert-type scales and categorical items.

Familiarity

Respondents were asked four questions about their familiarity with and interest in learning more about cow dairy production and the nutritional properties of dairy products. Respondents could indicate whether they were 'not at all,' 'somewhat,' or 'very' familiar with cow dairy production and 'the nutritional properties of dairy products' and whether they 'would like to know more about' dairy production and the nutritional properties of dairy products. The percentages of respondents' familiarity with and interest are provided in Table 1. The most common response to questions about respondents' familiarity with dairy production and the nutritional products of dairy products of dairy products was that they were 'somewhat' familiar (68.6% and 71.6% respectively). In addition, over half responded that they would like to know more about cow dairy production (55.6%) and about two-thirds (66% indicated they would like to know more about the nutritional properties of dairy products.

Table 1. Familiarity and Interest in Dairy Production

*Familiarity and Interest in Dairy Production and Nutritional Properties of Dairy Production (*N = 410).

	Familiarity			Would like to know more		
	Not at all (%)	Somewhat (%)	Very (%)	Yes (%)	No (%)	
Cow dairy production	16.8	68.8	14.3	55.6	44.4	
Nutritional properties of dairy products	12.4	71.6	15.9	66.0	34.0	

Perceptions and Attitudes

Several batteries of questions assessed participants' attitudes and perceptions toward consumption of dairy and their own dairy consumption behaviors, attitudes toward sustainability in general and in food production, technology's perceived impact on food production, animal welfare, and the economics of dairy production. These items were measured on a 5-point, Likert type scale with answer possibilities of 'Strongly disagree' (1), 'Disagree' (2), 'Don't know' (3), 'Agree' (4) and 'Strongly agree' (5). The wording for each item in addition to each item's mean and standard deviation is provided in Table 2. The items that participants expressed the strongest agreement included "Caretakers should help dairy cows to be healthy" (M = 4.69, SD = 0.69), "Cow's milk provides valuable nutrition for humans" (M = 4.16, SD = 0.81), and "I enjoy learning through immersive experiences" (M = 4.13, SD = 0.80). Participants expressed the least agreement with the statements "I avoid dairy products from cow's milk" M = 2.01, SD = 1.17), "I prefer plant-based milk alternatives (oat, coconut, almond) to cow's milk" (M = 2.71, SD = 1.48),

and "With guidance, I would consider owning and running a dairy to sell to a local community" (M = 2.14, SD = 1.13).

Notably the mid-point of the scale ('3') was labeled as 'Don't know'' (provided in the last column of Table 2). The research team is interested in creating educational materials using emerging media arts to help students and members of the public have accurate information about dairies and therefore we were particularly interested in the "Don't Know" responses. Over half of the participants selected "Don't know" in response to the statement "I prefer dairy products from small-or mid-sized dairies" (56.5%) and "Small dairy farms are economically viable" (56.7%). The percentages are not quite as high yet are substantial for the statements: "I prefer to buy dairy products produced locally" (40.8%); "It is better to have many small dairy operations than fewer large dairy operations" (46.4%), "There are dairy farms that benefit the environment (43.9%). The percentage of participants selecting "Don't know" varies considerably based upon the item (from a low of 6.1% for the statement "I enjoy learning through immersive experiences (handson or virtual reality) and 6.2% for "Cow's milk provides valuable nutrition for humans") to the items already mentioned with about 56% selecting "Don't know". Therefore "Don't know" responses seem to indicate that the participants either had not formed an opinion, did not have enough information to make an opinion, or were still making up their minds.

Based upon what we learned from this pilot study, the team will refine the survey measurement to use for more representative samples and will develop possible interventions to promote knowledge to help people have informed attitudes toward dairy production, processing, and products.

Table 2. Attitudes Toward Dairy Consumption, Sustainability, and Technology

Means, standard deviations, and percentages indicating 'don't know' for items measuring attitudes towards consumption, technology, sustainability, and animal wellbeing in dairy production. 1 = 'Strongly disagree; '2 = 'Disagree; '3 = 'Don't know; '4 = 'Agree; 'and

5 = 'Strongly agree.' N = 410.

	М	SD	Don't know (%)
Consumer Attitudes and Behaviors			
Cow's milk provides valuable nutrition for humans.	4.16	.81	6.2
I prefer to buy dairy products produced locally.	3.52	.87	40.8
Price is the only factor I consider when purchasing milk.	2.71	1.14	11.2
I prefer dairy products from small- or mid-sized dairies.	3.12	.75	56.5
It is better to have many small dairy operations than fewer large dairy operations.	3.49	.79	46.4
I prefer plant-based milk alternatives (oat, coconut, almond) to cow's milk.	2.71	1.48	9.1
I avoid dairy products from cow's milk.	2.01	1.17	6.5
Sustainability Being "carbon neutral" means taking steps to offset or balance out the carbon	3.80	.83	31.6
emissions we produce.	5.80	.03	51.0
There are dairy farms that benefit the environment.	3.46	.86	43.9
The sustainability of our food system is important to me personally.	4.09	.78	7.9
Technology			
Technology will improve the wellbeing of animals in agriculture.	3.84	.90	25.8
Technology will improve the livelihoods of people working in agriculture.	4.09	.72	15.1
Technology will make dairy production more sustainable.	3.83	.84	29.4
Animal Welfare			
Caretakers should help dairy cows to be healthy.	4.46	.69	7.1
Animals on farms can have a good life.	3.97	.97	13.7
The welfare of dairy cows is important to me personally.	3.77	.98	19.6
Economics of Dairy Production Small dairy farms are economically viable.	3.36	.74	56.7
I would like to own my own business.	3.13	1.17	22.7
-			
With guidance, I would consider owning and running a dairy to sell to a local community.	2.14	1.13	15.6
Learning			
I enjoy learning through immersive experiences (hands-on or virtual reality).	4.13	.80	6.1

Several of the bivariate correlations are positive, substantial, and have p-values less than .05, suggesting that they are measuring similar underlying concepts, but none are so high as to suggests that they are measuring the same thing (i.e. all are below r=.60). Because the sample does not meet one of the basic assumptions for significance testing, we use the p-values as a heuristic to guide notable associations but do not claim to generalize to a larger population. The largest correlation is between the statements "The sustainability of our food system is important to me personally" and "The welfare of dairy cows is important to me personally" (r = .39, p < .01); the next largest was between the statements "I would like to own my own business" and "With guidance, I would consider owning and running a dairy to sell to a local community" (r = .37, p < .01). There was also a substantial and positive correlation between the items "It is better to have many small dairy operations than fewer large dairy operations" and "Small dairy farms are economically viable" (r = .27, p < .01).

Correlations of items related to personal consumption of dairy products (matrix in Table 3) showed a positive correlation between respondents indicating "I prefer to buy products locally" and "I prefer dairy products from small-or mid-sized dairies" (r = .39, p < .01). There was a negative correlation between "I prefer to buy dairy products produced locally" and "I avoid dairy products from cow's milk" (r = .15, p < .05), which is likely attributed to those participants who avoid purchasing or consuming these products. There was a strong, positive correlation between the item "I prefer plant-based milk alternatives" and "I avoid dairy products from cow's milk (r = .67, p < .01).

Table 3. Correlations Between Items Measuring Personal Consumption of Dairy

Correlations between items related to personal consumption choices related to dairy products.

N = 410.

ariable	1	2	3	4
 I prefer to buy dairy products produced locally. 				
2. Price is the only factor I consider when purchasing milk.	03			
3. I prefer dairy products from small- or mid- sized dairies.	.39**	04		
4. I prefer plant-based milk alternatives (oat, coconut, almond) to cow's milk.	10	06	.05	
5. I avoid dairy products from cow's milk.	15**	06	.06	.67*

Note. * indicates p < .05. ** indicates p < .01.

Correlations between items measuring perceptions of the impact of technology on animal wellbeing, people working in agriculture, and the sustainability of dairy production (matrix in Table 4) showed a positive correlation between all items. This suggests a sense of overall optimism toward the role of technology in agriculture in terms of animal welfare, agricultural workers, and enhancing agricultural sustainability. These three items seem to form a scale measuring degree of positive attitudes towards technology in agriculture.

Table 4. Correlations Between Items Measuring Perceptions of Technology

Correlations between items related to the impact of technology on animal wellbeing, people

working in agriculture, and sustainability in dairy production. N = 410.

ariable	1	2
1. Technology will improve the wellbeing of animals in agriculture.		
2. Technology will improve the livelihoods of people working in agriculture.	.48**	
 Technology will make dairy production more sustainable. 	.68**	.52**

Note. * indicates p < .05. ** indicates p < .01.

Career Interests

Three items asked participants 'which of the following career fields interest you', including agriculture, technology, and sustainability. Respondents could indicate either 'not at all,' 'somewhat' or 'very' interested in each career field. Table 5 depicts the percentage of respondents who indicated each level of interest to these different career types. About half of participants indicated they were 'not at all' interested in agriculture as a career field (although about half indicated they were 'somewhat' or 'very' interested in this career field), followed by participants saying they were 'not at all' interested in technology (20.6%) and then sustainability (17.4%) careers. Eighty-two percent indicated they were 'somewhat' or 'very' interested in a career in sustainability and 79.4% indicated they were 'somewhat' or 'very' interested in a career in technology. A larger percentage of men (56.8%) indicated they were somewhat or very interested in a career in agriculture, compared to women (44.6%), even though recent data suggests gender parity in the agriculture sector of the economy on the U.S. (cite). Although the difference is not as large as for agriculture, more women were interested (somewhat or very) in a

career in sustainability (84.6%) than men (78.21%), even though recent data suggests that most sustainability scientists are men (Zippia, 2023), and more men indicated interest a career in technology (87.7%) than women (74.5%), although the proportion of women interested in technology jobs is higher than the current representation (about 25%) (Techfunnel, 2023). The survey respondents who received the survey via a College of Agriculture Sciences and Natural Resources (CASNR) class or on the CASNR campus were more likely to be interested in the career fields listed than those who took the survey in a sociology course; 84.5% of respondents from CASNR and 75.9% from the sociology course were 'somewhat' or 'very' interested in a career in technology; and 70% of students from CASNR and 36% from the sociology course were interested in a career in agriculture.

Table 5. Career Interests

Percentages of respondents indicating career fields that interest them. Response possibilities included 'Not at all,' 'Somewhat,' and 'Very.' N = 410.

	Not at all (%)	Somewhat (%)	Very (%)
Agriculture	49.9	34.0	16.2
Technology	20.6	44.3	35.1
Sustainability	17.4	51.3	31.0

Correlations between the items measuring career interests show positive correlations between all three career types (agriculture, sustainability, and technology). These items were measured as an ordinal variable with three scale points (1-3). A matrix of the Pearson's r correlations is shown in Table 6.

Table 6. Correlations Between Career Interest Variables

Correlations between items measuring interest in agriculture, technology, and sustainability

career fields. N = 410.

Variable	1	2	3	4
 Agriculture Technology Sustainability 	.23** .21**	.28**		

Note. * indicates p < .05. ** indicates p < .01.

Interacting with Displays and Immersive Learning

Students who completed the survey on April 20, 2023, at UNL's Dairy Store had the opportunity to view designs depicting a potential small-scale, robotic dairy facility, developed by design class during the fall semester of 2022. Participants at this location were asked whether they had viewed the displays and, if so, whether they learned from them or generated interest. If participants indicated 'yes' that they have viewed the dairy designs exhibited (n = 71), they were asked whether they agreed or disagreed that" "the displays helped me understand how a facility like this might work," "the displays made me excited about the idea of a robotic dairy on campus," "It is important that UNL have a publicly accessible dairy on campus," and "I would visit a dairy facility like the ones I saw on display if it were on campus." Only 40 participants responded to this complete set of questions. The means and standard deviations of the items measuring respondents' experiences with the displays are provided in Table 7. Overall, the responses indicated high agreement with these statements, with means ranging from 4.40 to 4.49. The standard deviation for the item about the importance of having a publicly accessible dairy was slightly higher (SD = .74), while responses to other questions about the displays were homogenous (SD = .50).

Table 7. Perceptions of Dairy Facility Displays

Means and standard deviations of respondents' perceptions of the dairy designs exhibited at

UNL's Dairy Store, among those who said that they saw them and that answered the questions

about them (n = 40) on April 20, 2023.

	М	SD
The displays helped me understand how a facility like this might work.	4.42	0.50
The displays made me excited about the idea of a robotic dairy on campus.	4.45	0.50
It is important that UNL has a publicly accessible dairy on campus.	4.40	0.74
I would visit a dairy facility like the ones I saw on display if it were on campus.	4.49	0.51

Scale from 1 ('Strongly disagree') to 5 ('Strongly agree').

Appendix A.

Qualtrics Survey Instrument

Consent

IRB Project ID #: 22758 IRB Approval #: 20230422758EX

Study Title: Attitudes Towards Dairy, Technology, and Sustainability (Pilot)

The purpose of this research is to understand consumers' perceptions of dairy production. If you are 19 years of age or older, you may participate in this research.

Participation in this study will require approximately 5 minutes. You will be asked to complete a survey on your smartphone or personal device. Participation will take place in a place of your choosing.

Reasonable steps will be taken to protect the privacy and the anonymity of study data; however, in some circumstances we cannot guarantee absolute privacy and/or confidentality.

Research records will be stored on a secure, password-protected UNL computer. Records will only be seen by the research team and/or those authorized to view, access, or use the records during and after the study is complete.

If you have questions about this project, you may contact Dr. Heather Akin at heather.akin@unl.edu or (402) 472-8787.

If you have questions about your rights or complaints about the research, contact the UNL Institutional Review Board (IRB) at (402) 472-6965 or irb@unl.edu.

You can decide not to be in this research study, or you can withdraw at any time before, during, or after the research begins for any reason. Deciding not to be in this research study or deciding to withdraw will not affect your relationship with the investigator, the University of Nebraska-Lincoln. You will not lose any benefits to which you are entitled. You are voluntarily making a decision whether or not to participate in this research study.

By clicking on the "I Agree" button below, your consent to participate is implied. You should print or save a copy of this page for your records.

I agree
 I do not agree

Age

What is your age?

- 18 or younger
- O 19 or older

Did you view the dairy designs exhibited at the UNL Dairy Store?

O No O Yes

O I'm not sure

Please indicate how much you agree or disagree with the following statements **about the displays**.

	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
The displays helped me understand how a facility like this might work.	0	0	0	0	0
The displays made me excited about the idea of a robotic dairy on campus.	0	0	0	0	0
It is important that UNL have a publicly accessible dairy on campus.	0	0	0	0	0
I would visit a dairy facility like the ones I saw on display if it were on campus.	0	0	0	0	0

How familiar are you with cow dairy production and the nutritional properties of dairy products?

	How fa	amiliar are you	ı?	I would like to about	
	Not at all	Somewhat	Very	Yes	No
Cow dairy production.	0	0	0	0	0
The nutritional properties of dairy products.	0	0	0	0	0

Please indicate how much you agree or disagree with the following statements.

	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
Cow's milk provides valuable nutrition for humans.	0	0	0	0	0
l prefer to buy dairy products produced locally.	0	0	0	0	0
Price is the only factor I consider when purchasing milk.	0	0	0	0	0
l prefer dairy products from small- or mid-sized dairies.	0	0	0	0	0
It is better to have many small dairy operations than fewer large dairy operations.	0	0	0	0	0
l prefer plant-based milk alternatives (oat, coconut, almond) to cow's milk.	0	0	0	0	0
I avoid dairy products from cow's milk.	0	0	0	0	0

	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
Being "carbon neutral" means taking steps to offset or balance out the carbon emissions we produce.	0	0	0	0	0
There are dairy farms that benefit the environment.	0	0	0	0	0
The sustainability of our food system is important to me personally.	0	0	0	0	0

Please indicate how much you agree or disagree with the following statements.

Please indicate how much you agree or disagree with the following statements.

	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
Technology will improve the wellbeing of animals in agriculture.	0	0	0	0	0
Technology will improve the livelihoods of people working in agriculture.	0	0	0	0	0
Technology will make dairy production more sustainable.	0	0	0	0	0

Please indicate how much you agree or disagree with the following statements.

	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
Caretakers should help dairy cows to be healthy.	0	0	0	0	0
Animals on farms can have a good life.	0	0	0	0	0
The welfare of dairy cows is important to me personally.	0	0	0	0	0

Please indicate how much you agree or disagree with the following statements.

	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
Small dairy farms are economically viable.	0	0	0	0	0
I would like to own my own business.	0	0	0	0	0
With guidance, I would consider owning and running a dairy to sell to a local community.	0	0	0	0	0
l enjoy learning through immersive experiences (hands-on or virtual reality).	0	0	0	0	0

Which of the following career fields interests you?

	Not at all	Somewhat	Very much
Agriculture	0	0	0
Technology	0	0	0
Sustainability	0	0	0
Are you a student?			
O Undergraduate student			
O Graduate student			
O Not a student			
What is your gender identit	ty?		
O Male			
O Female			
O Non-binary / third gende	r		
Prefer not to say			

Is there anything you would like to add about the dairy industry, sustainability, technology, or animal wellbeing?

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Appendix B.

Recruitment Sticker



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