Methods

Teaching Approaches to Ethical Generative Artificial Intelligence Use in Agricultural Economics Classrooms

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Abstract
With the introduction of generative artificial intelligence (AI)-powered tools, such as ChatGPT, Google Gemini, Copilot, and others, professionals and students in higher education institutions have altered their approaches to teaching and learning. While varying opinions exist on the implementation of AI in higher education, there is need for both students and educators to understand the ethical dimensions of its use for both students and educators. This article demonstrates a three-module instructional approach for integrating generative AI and its ethical use into undergraduate coursework. The modules include (1) AI introduction, (2) how to use AI, and (3) ethical dimensions. The three-module approach was implemented in a first-year, computer-based course designed to develop skills for agribusiness decision making. Students reported improved understanding of generative AI and its ethical implications after completing the lecture, irrespective of section or class level. This modular framework offers a practical guide for instructors aiming to integrate ethical AI education into agricultural economics curricula.

1 Motivation

Artificial intelligence (AI) has permeated many aspects of day-to-day lives, and the realm of education is no different. While AI has been studied in education literature for over 2 decades, most early research focused on nongenerative applications (Roll and Wylie 2016). Recent developments in generative AI, such as ChatGPT and Gemini, have significantly expanded capabilities of AI tools, allowing them to generate original content. This differs from earlier applications of AI in education, which focused on rule-based systems or predictive analytics rather than content generation. These developments raise new instructional opportunities as well as important questions about appropriate use, limitations, and ethical implications within specific disciplinary contexts.

The purpose of this article is to describe and implement a structured three-module framework for teaching generative AI and its ethical use in an undergraduate agricultural economics course. Its contribution is to provide a discipline-specific teaching approach that integrates applied use of generative AI with explicit attention to ethical considerations and instruction reflection, responding to the rapid pace at which these tools are evolving in education settings.

A recent report indicated that 60 percent of college teachers surveyed actively use generative AI in the classroom (Hamilton 2023). The literature identifies multiple approaches for teaching AI, including structured instructional models, experiential learning through games and simulations, and visual tools that support student learning in both classroom and online settings (Hingston et al. 2006; Wollowski et al. 2016; Yang et al. 2020; Wangenheim et al. 2021; Falk and Inie 2022; Laupichler et al. 2022).

The benefits of AI integration into secondary and postsecondary curriculum have been documented in recent literature (Wu and Wu 2020; Grunhut 2022; Tatar et al. 2024). Implementation of AI into course material has primarily been focused on increasing general exposure, literacy, and AI use among students. In recent years, course designers have also incorporated AI to personalize the curriculum to meet the needs of students in the course (McBride 2021). ChatGPT has been implemented across various subjects—such as chemistry, mathematics, journalism, finance, business, and computer information systems—to enhance the knowledge and skillset of students as well as assess the impact on testing procedures (Moore et al. 2022; Frieder et al. 2023; Pavlik 2023; Wardat et al. 2023).

Studies have highlighted the potential applications of AI and machine learning[1] within agricultural and applied economics research and training (Baylis et al. 2021; Lu et al. 2022). Examples include gathering and analyzing data as well as improving econometric modeling and estimation. These tools provide opportunities for personalized learning as well as instructional support (Hooda et al. 2022).

Given the reliance of agricultural and applied economics on technology to conduct analyses and draw conclusions from data, it is important for faculty and instructors to prepare students for careers where these tools can be used effectively, efficiently, and ethically. Students in these programs are increasingly exposed to generative AI, but few undergraduate curricula offer structured, discipline-specific instruction on how to use these tools effectively and ethically. Without targeted guidance, students risk using AI tools in ways that are misaligned with academic integrity policies or professional standards.

Although the rate of adoption of AI techniques into curricula has increased in recent years, concerns remain about effective adoption strategies, the selection of appropriate AI content, and the ethical implications of use (Laupichler et al. 2022; Wazan et al. 2023). For AI-based teaching approaches to be effective, courses must be designed with careful attention to both (1) the strengths and limitations of AI and (2) the primary objectives of the course (Wazan et al. 2023). Recent studies have further examined the use of AI in classrooms, identified ethical challenges associated with AI in education, and proposed guidelines to support responsible implementation (Akgun and Greenhow 2022; Brown et al. 2023; Cardona et al. 2023; Dwivedi et al. 2023; Kurni et al. 2023; Nguyen et al. 2023).

Ethical concerns surrounding data technologies are not new in agriculture. Prior work has examined issues of accuracy, ownership, bias, privacy security, and labor force implications in the context of big data and precision agriculture technologies (Castle et al. 2015; Coble et al. 2018; Mark 2019; Manning et al. 2022). Generative AI raises similar but more immediate concerns in education. The accuracy of outputs can vary widely, sometimes producing misinformation or "hallucinations" (Azamfirei et al. 2023). Questions of ownership and intellectual property arise when AI systems generate text or images based on copyrighted training data. Privacy and security concerns stem from the sensitive information users may input into AI systems. Finally, there are concerns about plagiarism and academic integrity, as AI-generated content can blur the boundaries between student and machine work. These issues are noticeable given the large accessibility of generative AI tools and the challenges they pose for detecting student use of these technologies with online exams, written essays, and other assessment types (Darvishi et al. 2022; Gamage et al. 2022; Tweissi et al. 2022; Shear et al. 2023; Fleckenstein et al. 2024).

While studies have focused on the implementation of generative AI tools in courses, few have examined structured approaches that integrate both application and ethics. The instructional approach has three objectives: (1) introduce foundational concepts and applications of generative AI, (2) provide

[1] While the terms AI and machine learning (ML) are sometimes used interchangeably, ML refers specifically to algorithms that improve their performance by learning from data, whereas AI is a broader field that includes systems capable of simulating human intelligence. Generative AI, the focus of this article, is a type of ML that creates new content—such as text, code, or images—based on patterns learned from massive training datasets.

students with hands-on experience writing and refining AI prompts, and (3) develop ethical awareness through guided discussions and applied reflection activities.

The remainder of this article proposes a lesson tailored specifically to an agricultural economics and agribusiness course aimed at introducing AI, the academic and vocational uses of AI, and the ethical dimensions of AI. Section 2 describes the development and application of the lesson, followed by the evaluation method to determine effectiveness. Finally, a discussion of the effectiveness of the application is provided along with concluding remarks.

2 Course Context and Teaching Modules

The instructional framework was designed to help students develop a foundational understanding of generative AI, including how it differs from earlier forms of artificial intelligence. Through the modules, students gained experience using AI tools by writing effective prompts and evaluating the quality of AI-generated outputs. In addition to building functional skills, the modules encouraged students to think critically about appropriate use cases, limitations, and ethical concerns—including issues such as bias, misinformation, plagiarism, and intellectual property—in both academic and professional settings. Table 1 provides an overview of each module's purpose, content, instructional activities, and key sources (Anyoha 2017; Cornell University Center for Teaching Innovation n.d.a,b; MIT Sloan Teaching & Learning Technologies n.d.; Sheridan College Library and Learning Services n.d.).

Table 1. Summary of AI instructional modules

Module	Learning Emphasis	Core Content Topics	In-Class Activity	Key Sources
What Is AI?	Define generative AI and distinguish from historical AI	Definition of AI and generative AI, brief history, daily and agriculture examples	Class discussion on uses and limitations of AI	Harvard – Science in the News (Anyoha 2017) Cornell – Center for Teaching Innovation (Cornell n.d.a, AI Assignment Design)
How to Use AI	Apply prompt-writing strategies for task-specific outputs	Elements of effective prompts (role, task, requirements, instructions); ChatGPT use	Group prompt comparison and individual writing exercise	Sheridan – Academic Skills Hub MIT – Sloan Teaching & Learning Technologies (MIT Sloan Teaching & Learning Technologies n.d.)
Ethical and Responsible Use of AI	Identify and evaluate ethical issues in academic and agriculture contexts	Bias, misinformation, hallucinations, intellectual property, academic policies	Small-group analysis of ethical case scenarios and class debrief	Cornell – Center for Teaching Innovation (Cornell n.d.b, Ethical AI for Teaching and Learning) University specific resources and policies

With the rapid evolution of AI, the primary focus of the three-module framework presented in this paper was to enhance the students' understanding of the ethical and efficient uses of AI. Focusing on any specific AI skills could lead to quickly outdated content. The lesson was intended to be implemented in one 90-minute lecture or two 50-minute lectures.

The first module, "What Is AI?" introduced students to core concepts of AI, including a brief history, provided examples of uses in everyday life and agriculture, and highlighted key limitations of current AI tools. Module two, "How to Use AI," showed how to make a ChatGPT account, covered writing effective prompts, and included a prompt-writing activity in ChatGPT. The third module, "Ethical and Responsible Use of AI," focused on issues related to bias and misinformation in AI, intellectual property, plagiarism, and the ethical use in school and learning environments. Rather than prescribing a single definition of ethical behavior, the module emphasized key themes identified in key sources and used these as a framework for structured discussion. This approach was intended to balance providing students with guidance while also encouraging critical reflection on how ethical considerations apply in diverse contexts. Following the ethics module, a second activity was implemented to support an instructor-facilitated discussion on the ethical use of generative AI. This activity was designed to prompt reflection and discussion around appropriate use, limitations, and professional expectations associated with AI tools. Lecture slides for this activity can be found in the supplementary materials.

2.1 Development of Modules

The instructional modules were implemented in Decision Tools for Agricultural Economics and Agribusiness, a four-section course with a combined total of 104 students in the Fall 2023 semester. The course is required for all agricultural economics and agribusiness majors at Kansas State University. The course is taught at the freshman level; however, since it is a required course and a prerequisite for other courses, students of all grade levels take the course.

The course emphasizes applied Microsoft Excel skills in business contexts and includes daily, computer-based exercises, and spreadsheet software in business settings. The course is highly interactive, with daily workbook activities. Each section was taught by a different graduate student in the third year of their PhD program. Each instructor was free to set their own grading structure and course timeline; however, content was consistent across sections of the course. Classes were held twice a week for 50 minutes, with meeting time varying by section.

Two 50-minute class periods at the end of the semester were reserved for advanced topics not covered on the final exam. In Fall 2023, the topic selected was artificial intelligence and its ethical use. While the module was not heavily weighted in course grades, the timing offered a low-stakes opportunity for experimentation. As such, the results are likely to reflect a lower-bound estimate of student engagement and learning. Table 2 presents section-level characteristics of students who participated in the study. These modules were delivered across two 50-minute class sessions. The following sections describe each module and the instructional materials used. This design aligns with the broader framework outlined in Section 2, where the focus was placed on developing durable skills, such as understanding ethical and responsible use, alongside functional practice since technical detailed to specific AI tools can change rapidly over time.

2.2 Lecture Modules

In the first module, the lecture content began with introducing AI, then specifically defining generative AI and its features. Given the introductory nature of this lesson, a brief history of AI was included. The historical AI content was derived from the Harvard Science in the News blog (Anyoha 2017). The lesson discussed ways AI is already involved in our daily lives (Marr 2019). Relevant examples were drawn to accommodate the student audience. Connecting the topic to agribusiness, the lesson gives examples of AI

use in agricultural production and decision making. Examples include IBM's Watson Decision Platform for Agriculture (https://www.ibm.com/downloads/cas/ONVXEB2A).

Table 2. Summary statistics of class section demographic variables

	Section A	Section B	Section C	Section D	Total Sample
Final grade (course)	88.3%[a]	93.7%[b]	88.0%[a]	95.9%[b]	90.6%
Quiz grade	89.1%[a]	93.4%[a]	93.0%[a]	95.8%[a]	92.0%
Major (vs. Nonmajor)	96.9%[a]	73.1%[b]	84.2%[a,b]	87.5%[a,b]	85.9%
Class level (count)					
Freshman	19	17	8	6	50
Sophomore	4	4	5	2	15
Junior	9	3	3	0	15
Senior	0	2	2	0	5
Total	32	26	19	8	85

Note: Lowercase letters denote statistical difference. Values that are statistically different from another have different letters. Values with more than one letter indicate that value is not statistically different from two numbers that are statistically different from each other.

The module facilitated class discussion on the potential academic, professional, and personal benefits of using AI. Students brainstormed practical uses of AI, such as enhancing writing, troubleshooting spreadsheets, or personal decision-making. Common examples included using grammar and spell check AI tools to reduce errors in writing assignments and cover letters, finding errors in Microsoft Excel formulas, or even more efficiently finding a movie to watch.

The discussion of uses for AI was then supplemented with discussion about what AI cannot do, drawing from Cornell AI's teaching resources (Cornell University Center for Teaching Innovation n.d.a,b). Emphasizing limitations is critical because students may overestimate the capability of these tools. Prior literature highlights that generative AI cannot engage in metacognition, synthesize across disciplines, or replace human interaction in collaborative learning (Wu 2023; Cash and Oppenheimer 2024; Shen et al. 2025). It also depends on past training data, limiting its ability to provide reliable insight on current events and reproducing biases present in the training data. The first module, "What Is AI?" was therefore designed to introduce AI, provide examples of applications in agriculture and other domains, and highlight its limitations.

The second module, "How to Use AI," focused on applied use of ChatGPT, which was selected because of its widespread adoption and discussion in both scientific and popular media (Baidoo-anu and Ansah 2023). Students were guided in creating accounts and prompted to review OpenAI's "Tips for Getting Started" (see Figure 1) before use. This pause served as a bridge to the later ethics modules, ensuring students engaged with AI tools while remaining mindful of associated risks.

Efficient use of ChatGPT begins with an effective prompt. The usefulness of the output is tied directly to the content of the prompt. An effective prompt includes four elements: (1) role, (2) task, (3) requirements, and (4) instructions (University of Lincoln Digital Education Support Services n.d.a). The role conveys the level of information required. For example, a beginner Excel user would require information on Excel to be provided at a different level than a fourth-year agribusiness student. By specifying the desired level of information, the output is more likely to serve the intended audience's level of understanding. The second element of an effective prompt, the task, requires details about the desired task to be completed. When describing the task, more detailed explanations will yield more

tailored outputs. The next element is the requirements, which defined parameters to be followed and assumptions that should be made. Anything not provided by the user will be assumed by ChatGPT. Finally, the prompt should include instructions on how the user would like to receive the information.

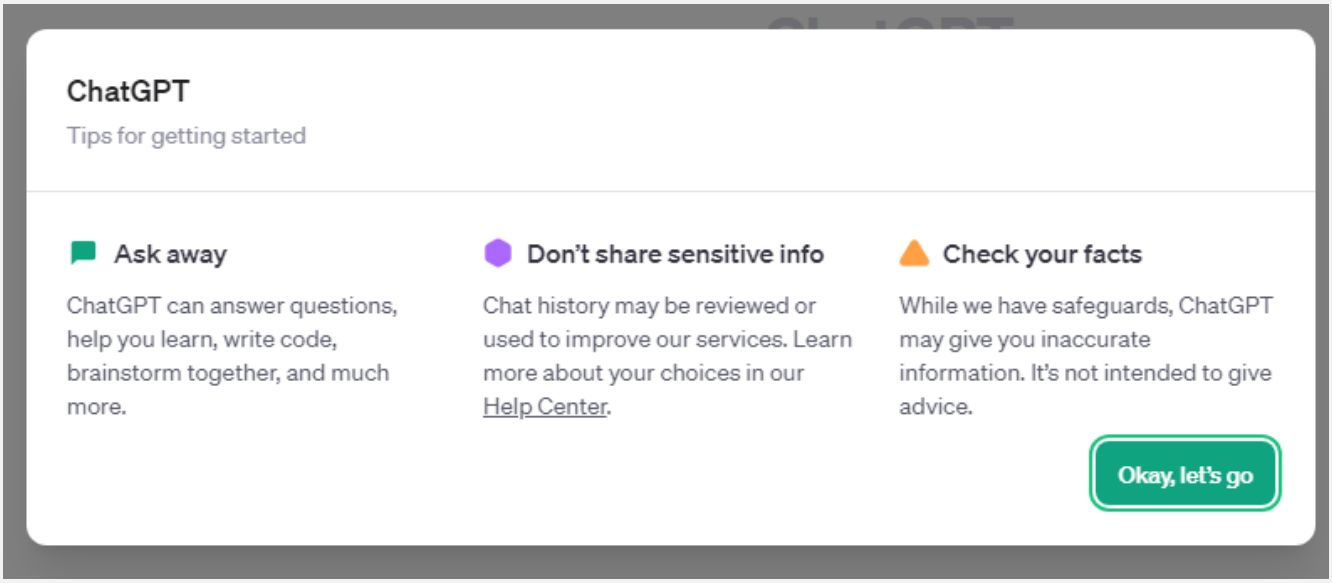

Figure 1. ChatGPT tips for getting started

Source: OpenAI (2025).

After discussing the elements of a prompt in abstract, concrete examples were given. The value of a well-designed prompt is demonstrated by giving ChatGPT a simple prompt, missing many of the described elements, after which an improved, efficient prompt was given for the same task. The class was asked to compare the output from each prompt. Students were able to identify components of the output that were improved by strategically providing the elements of an efficient prompt. After the group exercise, students engaged in an individual application exercise, described in Section 2.3. In a 50-minute class session, the second module and first lecture period conclude after the exercise.[2]

The second lecture focused solely on the ethical implications and responsible applications of AI. The topics discussed in this module broadly fall into issues of (1) bias and misinformation, (2) intellectual property, and (3) school and learning environments. These categories were developed using resources from the University of Lincoln, Cornell, and Harvard Business Review as well as internal institutional resources (University of Lincoln Digital Education Support Services n.d.b; Cornell University Center for Teaching Innovation n.d.a,b; Appel et al. 2023). Since AI is trained with existing data, AI can perpetuate and amplify discriminatory bias and reinforce stereotypes. The point is exemplified with recent news articles identifying bias in AI products (Dastin 2018; Getahun 2023). As such, AI outputs should be viewed with a critical eye. The lesson then covered techniques helpful in spotting bias in AI, using recommendations from Cornell's Center for Teaching and Learning. The lesson highlighted the importance of verifying the information and thinking critically about the sources AI is drawing from. The lecture also introduced the concept of hallucinations. For example, a student using ChatGPT to debug code in specialized software like SAS or STATA may receive output that appears convincing but is entirely fabricated. In these cases, hallucinations can be difficult to detect, especially when students or

[2] In a single 90-minute lecture, the instructor could instead indicate a transition in topic and proceed with the third module of ethics.

professionals are unfamiliar with the content. This highlights the importance of verifying AI-generated information using trusted, external sources. These discussions helped students better understand the risk of over-reliance on generative AI tools in both academic and professional settings.

The next ethics concept covered intellectual property and information in the context of AI. Since information provided to AI is used for future training, users must not share private or proprietary information in AI like ChatGPT. Students should also be aware of the policies and procedures related to AI for any current and future employers. Concerns about data privacy may influence the scope of AI use for many companies, and as such it is up to the students to make themselves aware of policies. The same principle applies to academic settings. The lecture then discussed intellectual property, an issue that is still heavily litigated. Due to the fluid nature of this topic, the lecture directed students to university resources related to generative AI and copyright law. The primary focus during this component of the lesson was to help students identify resources to answer questions, since providing content on the current state of generative AI intellectual property would quickly become outdated.

Since this was designed specifically for first-year students, the ethics module also covered using AI for schoolwork and learning. The discussion began by outlining the benefits and drawbacks of incorporating AI into schoolwork. Some of the benefits include personalizing learning, improving study tools, and clarifying and reducing errors in written work. On the other hand, relying heavily on AI can limit creative development, give false information, or create plagiarism and intellectual ownership concerns. It is the responsibility of the student to read the syllabi for courses carefully and understand what uses of AI are acceptable for each course. Students should feel empowered to use AI as a tool to further learning if allowed by their course instructor, but not as a replacement for effort and introspection. Following the ethics module, the lesson incorporated an ethics application exercise, described in Section 2.4.

2.3 AI Use Application Exercise

The interactive application exercise aimed to give students hands-on practice developing their prompt-writing skills. Students were instructed to write a basic prompt and an informative prompt on the same subject, just as the full class had done previously. After comparing outputs, students revised their prompts to improve clarity and relevance.

The provided example topics included: finding a recipe to cook, creating a study plan for a final exam, and learning about elasticity. Example topics were selected to have elements that could benefit by improving the prompt while also being relevant to a typical student. For example, the recipe example highlighted the benefit of setting clear parameters, matching ingredients and cooking utensils available, dietary needs and preferences, and time constraints. Without providing explicit parameters, ChatGPT makes assumptions that could greatly reduce the effectiveness of the output. In the study plan example, specifying course level and desired format (e.g., hourly versus daily) helps generate more useful output. Finally, details in the elasticity prompt are essential for learning about a new topic, especially when wanting to learn about elasticity in an economic rather than a physical science context.

After students experimented with ChatGPT on their own, they were given the opportunity to share and discuss with the full class. The group discussion uncovered different ways of approaching the same topic. For example, some students discovered the value of adding “only” to a list of ingredients given in a recipe as an additional parameter. Others found value in giving specific elasticity examples to learn from, so they could relate better to the output. In total, the application exercise was vital in allowing students to experiment with ChatGPT while also learning from their peers’ experience.

2.4 Ethics Application Exercise

The objective of the ethics application exercise is to help students to understand what is ethically acceptable when using AI and what should be cautioned against. Students were given four hypothetical tasks and asked how they would use AI to complete them ethically and what they should be cautious of or avoid using AI to complete. The four proposed activities were (1) writing an essay on irrigation use, (2) determining the health impacts of energy drink consumption, (3) creating an art project in the style of van Gogh, and (4) creating a tool to organize farmers' data.

Students reflected on the task in small groups before sharing with the full class. Each of the activities was designed to prompt reflection on a specific ethical concern. The essay task encouraged students to define ways AI could improve essay writing without concerns of plagiarism. The health tasks required students to think critically about the sources of information that AI was likely to draw from and identify whether they were reliable. The art project task encouraged students to leverage AI to encourage creativity rather than dampen it. Finally, the tool for farmers spurred brainstorming for ways to use AI that did not require releasing private data. Small group discussions and full class debrief created a dynamic conversation about ethical AI use in both academic and professional contexts.

3 Application and Evaluation of Instructional Modules

Following the completion of all three modules, an in-class quiz was administered to evaluate realized and self-reported learning related to AI use and ethics. The quiz consisted of six multiple-choice content questions, of which three focused on AI applications and three focused on ethical applications. In addition, students were asked five Likert-scale questions, on a 5-point scale, about their prior use of AI, prior understanding of AI, current understanding of AI, intended future use in coursework, and intended future use in a career. The instructors collectively developed the quiz to prevent ad hoc variation. Table 3 provides a summary of survey responses. The quiz can be found in Appendix A.

Two Likert-scale questions measured students' self-reported understanding of AI before and after the lecture: (1) "Before the AI lecture, how would you rate your understanding of artificial intelligence?" and (2) "After the AI lecture, how would you rate your understanding of artificial intelligence?" Both were scored on a 5-point scale (1 = none, 5 = expert). "Amount learned," reported in Table 4, is calculated as the difference between post-lecture and pre-lecture responses. This measure reflected the students' perceived change in understanding rather than quiz-based performance. Given the timing near finals, a second quiz was deemed impractical relative to the potential information gain. Thus, a retrospective pre–post survey instrument was utilized (Davis 2002; Watson and Zhang 2021). In addition, since these questions captured the students' own perception of learning, which may be more closely tied to future use than an externally dictated quiz.

The quiz was graded and contributed to each student's final grade in the manner outlined in each section's syllabus. The context-based questions were graded on correctness, while the perception-based questions were awarded points based on completion. The questions were graded to encourage active participation and alleviate concerns about hypothetical bias. To avoid biasing self-reported responses, students were not told in advance that the lesson would be used for research purposes. The quiz questions were pre-emptively reviewed and approved by the university's Internal Review Board (IRB).

4 Results

Results from the in-class assessment are presented below, beginning with perceived learning gains followed by additional measures of student understanding and engagement.

Table 3. Summary of survey responses

	Section A	Section B	Section C	Section D	Total
Initial understanding					
None	3	2	2	0	7
Limited	12	11	8	3	34
Moderate	13	7	6	5	31
Good	4	6	3	0	13
Expert	0	0	0	0	0
Initial use					
Never	15	18	11	2	46
Rarely	5	5	4	4	18
Sometimes	11	2	3	2	18
Moderate	1	1	0	0	2
Very Often	0	0	1	0	1
After understanding					
None	1	0	0	0	1
Limited	0	0	0	0	0
Moderate	6	7	5	1	19
Good	23	18	13	7	61
Expert	2	1	1	0	4
Future coursework use					
Definitely Not	1	0	0	0	1
Probably Not	7	6	3	3	19
I Have No Idea	4	6	3	1	14
Probably	19	10	8	4	41
Definitely	1	4	5	0	10
Future career use					
Definitely Not	1	3	1	0	5
Probably Not	9	5	2	3	19
I have no idea	7	4	2	1	14
Probably	9	11	9	4	33
Definitely	6	3	5	0	14

Table 4. Amount learned by grade level and initial understanding

	Grade Level				
	Freshman	**Sophomore**	**Junior**	**Senior**	**Total**
Amount learned	1.200[a]	1.333[a]	1.267[a]	0.600[a]	1.2
	(0.099)	(0.211)	(0.182)	(0.510)	(0.082)
	Initial Understanding				
	None	**Limited**	**Moderate**	**Good**	**Total**
Amount learned	1.857[a]	1.706[b]	0.935[c]	0.154[d]	1.2
	(0.340)	(0.079)	(0.065)	(0.154)	(0.082)

Note: Values in parentheses are standard errors. Lowercase letters denote statistical difference. Values that are statistically different from another have different letters. Values with more than one letter indicate that value is not statistically different from two numbers that are statistically different from each other. "Amount Learned" refers to the difference between post-lecture and pre-lecture self-reported understanding of AI in response to the questions, "Before the AI lecture, how would you rate your understanding of artificial intelligence?" and "After the AI lecture, how would you rate your understanding of artificial intelligence?" (1 = none, 5 = expert).

4.1 Perceived Student Learning Gains

The lesson described in Section 2 is shown to be effective using evaluation methods described in Section 3. The quiz grade offers an objective measure of student understanding. The average post-lesson quiz score for all sections was 92 percent, exceeding the average final course grade. This suggests that after the completion of the lesson, students demonstrated a high degree of understanding of the basic application and ethical principles of AI.

In addition to a high degree of understanding, students also reported gains in the amount learned about AI through the Likert-scale responses. As shown in Table 4, students on average reported a 1.2-point increase in perceived understanding. Importantly, students learned irrespective of their grade level. Levels of learning are statistically equivalent at the 5-percent significance level. This finding supports the broader applicability of the lesson beyond first-year students, even though the content was designed with that group in mind.

Yet initial understanding of AI did influence reported learning gains. Students with no prior knowledge of AI reported the largest increases in understanding (1.86 points), followed by those with limited knowledge (1.71 points). On the other hand, students who had a moderate or good understanding reported more modest gains. Students who began the module with a moderate level of prior understanding reported an average gain of 0.94 points, while those with good prior understanding reported a gain of 0.15 points. Although these increases were smaller than those for students with little or no prior knowledge, they still indicate some added value for more experienced learners. Variation across course sections appeared to be linked primarily to differences in students' prior AI familiarity rather than their academic standing or major. For example, the section with the highest portion of students reporting moderate to good prior AI knowledge showed the smallest average gains. These differences were statistically significant and suggested that the lesson is particularly valuable for students with limited prior exposure to AI tools.

These findings highlight the importance that prior experience with AI, not academic class level, is the strongest predictor of learning. This highlights the need for accessible AI instruction across curriculum, regardless of a student's year in school. Even modest exposure to AI and its ethical implications can equip students with the tools to critically think and use emerging technologies responsibly in academic and professional settings.

4.2 Reflection of Instructors

Instructors observed that students were most engaged during the hands-on prompt-writing activity in Module 2 and the small-group ethics scenarios in Module 3. Many students were surprised at the limitations of generative AI, especially the occurrence of hallucinations and the difficulty in verifying AI-generated content in specialized agricultural contexts. The group discussion revealed a range of perspectives on ethical use, which encouraged peer-to-peer learning and critical thinking. In future iterations, the instructors plan to incorporate optional open-ended survey questions to capture qualitative insights from students and to explore ways of connecting these activities to employer expectations for AI use in agriculture fields. In addition, expanding the module to include examples from upper-level coursework could help students draw connections between introductory concepts and more advanced applications. Overall, the modules worked as intended, meeting the learning objectives and increasing student awareness of both the capabilities and ethical considerations of generative AI. An additional area for future exploration is incorporating perspectives from employers, as their expectations for how students should use AI in professional settings would further strengthen the alignment between classroom instruction and workforce needs.

Since the initial implementation of these modules, generative AI tools have continued to evolve. Although no formal data were collected beyond the period described, classroom experience suggests

greater student familiarity with these tools and increasingly nuanced student engagement during related discussions. These experiences reinforce the need for instructional approaches that remain adaptable as both technologies and student expectations continue to shift.

5 Conclusions

This paper outlines a modular approach to teaching AI and its ethical use within an agricultural economics classroom. The three-module framework presented in this paper, introducing AI, demonstrating practical applications, and exploring ethical considerations, was successfully implemented in a first-year, Excel-based course. Students across all academic levels demonstrated strong performance on a post-lesson quiz, with an average score of 92 percent, and reported meaningful improvements in their understanding of AI.

Although the lesson was designed for freshmen, the results suggest that students at all stages of their undergraduate careers benefit from guided instruction in AI use. Learning gains were highest among those with limited prior understanding, regardless of class standing. This highlights the value of targeted, accessible AI education, especially for students who may not have had prior exposure through other coursework or personal use.

Activities centered on writing effective AI prompts and evaluating ethical scenarios allowed students to move beyond abstract discussions and apply AI concepts to practical situations. These exercises encouraged students to think critically about how AI tools function, where they are most useful, and where caution is needed. This type of applied reasoning is significantly important for students entering fields like agricultural and applied economics, where data-driven tools must be used thoughtfully and responsibly.

Instructors across disciplines, particular those in technical or data-related fields, can adapt this framework to support ethical AI literacy among their students. As generative AI continues to evolve, it is important that higher education institutions equip students not only with the ability to use these tools but also with the judgment to use them responsibly.

For instructors, this framework offers a practical adaptable model for introducing generative AI literacy and ethics into discipline-specific courses. The combination of technical skill-building through prompt-writing and structured ethical reflection enables students to critically evaluate AI outputs and make informed decisions about when and how to use these tools. While increased student willingness to use AI following the modules reflects greater comfort and capability, it also showcases the importance of continued guidance on ethical boundaries. Incorporating similar modules across agricultural economics and related disciplines can help prepare graduates to navigate changing workplace expectations and responsibly leverage generative AI in professional practice.

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Appendix: Artificial intelligence Quiz

Multiple Choice – Application

1. Suppose you are a new graduate and have just started your first job as a loan officer at a large national bank. You have just assisted your first customer with a vehicle loan of $45,000. The customer is set to pay back the loan in monthly installments over the course of 5 years. They want to know what their monthly payment will be, including interest. You know the APR for this loan is 6.4%. Which of the following ChatGPT prompts will provide the most accurate and complete response?
    a. Provide ChatGPT with the loan amount and APR. Then ask ChatGPT to calculate adjusted interest rate.
    b. Provide ChatGPT with the loan amount and APR. Then ask ChatGPT to calculate loan payment using adjusted interest rate.
    c. Provide ChatGPT with the loan amount, APR, and number of periods. Then ask ChatGPT to calculate loan payment.
    d. Provide ChatGPT with the loan amount, APR, and number of periods. Then ask ChatGPT to calculate loan payment using adjusted interest rate.

2. In your agribusiness class, you're working on a project that requires optimizing resource allocation for farm operation. You have data related to crop yields, costs, and resource constraints in an Excel spreadsheet. You need to use Excel's Solver function. Which of the following prompts would be most effective for learning to apply Solver in Excel with ChatGPT's help.
    a. Ask ChatGPT “Explain the optimization algorithms in Excel Solver”
    b. Ask ChatGPT “Show me how to use Solver for calculating average crop yields in Excel”
    c. Ask ChatGPT “a step-by-step guide on using Excel's Solver for college agribusiness student”. Then ask ChatGPT for “specific examples on using solver for crop selection optimization to maximize profit”
    d. Provide ChatGPT with your data and ask it to use solver and find maximum profit.

3. Suppose you have two Excel sheets. In Sheet 1, you have a list of product IDs and their corresponding prices. In Sheet 2, you have a list of sales transactions with product IDs, and your goal is to look up the prices for each product. Using the IFERROR and VLOOKUP functions, you need to handle potential errors first and then find the prices. Which of the following prompts would be most effective in seeking ChatGPT's assistance to correct errors and efficiently retrieve prices for each product?
    a. Provide ChatGPT with what data you have: "I have a list of product IDs and their corresponding prices in Sheet 1 and have a list of sales transactions with product IDs in Sheet 2". Then ask ChatGPT to correct errors and find prices using the IFERROR and VLOOKUP functions.
    b. Ask ChatGPT “find prices for each product.”
    c. Ask ChatGPT “how to correct errors.”
    d. Ask ChatGPT “what are the IFERROR and VLOOKUP functions?”

Multiple Choice – Ethics

1. If you ask ChatGPT to summarize crop insurance statistics for the United States for the year 2019 using publicly available USDA data, what might you want to consider?
    a. If ChatGPT includes data from that year yet
    b. Who is included in the data summarized? (ie states, size of farms, organic farms, etc.)
    c. If the data used to summarize was private data
    d. Whether the output looks nice or not

2. Suppose your English professor asks you to write an argumentative essay about seatbelt laws in the United States. You must pick a side to argue – Pro or Con. The assignment is open resource, so you decide to enlist the help of ChatGPT to frame your essay. You provide ChatGPT with the prompt: "What are the pros and cons of seatbelt laws in the United States?" Which of the following actions is an ethical use of ChatGPT?
    a. You use the list provided by ChatGPT to build the primary argument(s) of your essay. There is no need to look for citations. ChatGPT provides original responses that no one else has written, so you can be sure that copying from ChatGPT does not count as plagiarism.
    b. You use the list provided by ChatGPT to build the primary argument(s) of your essay. There is no need to fact check this information or add citations, because ChatGPT always provides accurate information, with references cited.
    c. You use the list provided by ChatGPT to build the primary argument(s) of your essay. There is no need to fact check, because ChatGPT provides original responses that no one else has written. However, ChatGPT does not provide citations, so you must find your own sources and cite them accordingly.
    d. You use the list provided by ChatGPT to build the primary argument(s) of your essay. You don't add citations, because ChatGPT provides original responses that do not need to be formally cited. However, you fact check the information, because ChatGPT sometimes provides untrustworthy responses.
    e. You use the list provided by ChatGPT to build the primary argument(s) of your essay. You fact check the information, because ChatGPT sometimes provides untrustworthy responses. You also search for other sources that verify the information provided by ChatGPT and cite them accordingly.

3. Which of these is an ethical use of ChatGPT by a Student?
    a. Using ChatGPT to understand a topic better.
    b. Submitting a text generated by ChatGPT without citing it.
    c. Sharing ChatGPT-generated essays with classmates as their own work.
    d. Relying on ChatGPT for all written assignments without learning the material.

Basic Questions – Likert Scale

For the following questions, please select the answer that best fits your own knowledge/perception of AI.

1. Before the AI lecture, how would you rate your understanding of artificial intelligence?
    - ❑ None
    - ❑ Limited
    - ❑ Moderate
    - ❑ Good
    - ❑ Expert

2. Before the AI lecture, how often did you use ChatGPT?
    - ❑ Never
    - ❑ Rarely
    - ❑ Sometimes
    - ❑ A moderate amount
    - ❑ Very often

3. After the AI lecture, how would you rate your understanding of artificial intelligence?
    - ❑ None
    - ❑ Limited
    - ❑ Moderate

- ❑ Good
- ❑ Expert

4. Do you think you will use AI in other university courses in the future?
   - ❑ Definitely
   - ❑ Probably
   - ❑ I have no idea
   - ❑ Probably not
   - ❑ Definitely not

5. Do you think AI will be an essential part of your future career?
   - ❑ Definitely
   - ❑ Probably
   - ❑ I have no idea
   - ❑ Probably not
   - ❑ Definitely not

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