Journal of Applied Communications

Volume 107 | Issue 2 Article 5

Ready, Set, Communicate: Measuring Usability of Instructional Modules Designed to Improve Communications Skills of Students Studying Agricultural Sciences

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Recommended Citation

Murphrey, Theresa Pesl; Richburg, Audra W.; Leggette, Holli R.; Norris-Parish, Shannon L.; and Parrella, Jean A. (2023) "Ready, Set, Communicate: Measuring Usability of Instructional Modules Designed to Improve Communications Skills of Students Studying Agricultural Sciences," *Journal of Applied Communications*: Vol. 107: Iss. 2. https://doi.org/10.4148/1051-0834.2478

Ready, Set, Communicate: Measuring Usability of Instructional Modules Designed to Improve Communications Skills of Students Studying Agricultural Sciences

Abstract

Well-developed communications skills are essential to a proficient agricultural workforce. Online instruction via reusable learning modules (RLMs) is one way agricultural science faculty can provide their students with expert communications skills training. Although RLMs have many benefits, their value degrades rapidly if the learner cannot access or use the technology efficiently. Therefore, online instruction must be tested to ensure usability. The purpose of our study was to assess the usability of RLMs developed to bolster the communications skills of students studying in the agricultural sciences and provide guidance for future curricula and online instruction development. We used quantitative and qualitative data sources to assess the usability of three RLMs, according to $N = 21$ students. The usability metrics we assessed included learnability, navigation, video function, document access and readability, quiz and assignment practicality, and task difficulty. The RLMs garnered high usability scores from participants who had positive impressions and experiences completing them. Participants demonstrated an increase in confidence to perform communications skills and an increase in knowledge about communications after completing the modules. They thought embedded videos, documents, quizzes, and assignments were helpful in learning communications concepts. Some recommended improving navigation, document readability, and assignment details. Based on our findings, we recommend RLM developers embed short videos, printable handouts, and quizzes into RLMs, and include an overview of documents' key points to guide reading. Participants' positive feedback and willingness to engage with the RLMs suggests incorporating the RLMs into agricultural science courses will help students develop into science communicators.

Keywords

instructional design, online learning, reusable learning modules, science communications

Cover Page Footnote/Acknowledgements

This project was supported by Higher Education Challenge Grant no. 2017-70003-26386 from the USDA National Institute of Food and Agriculture.

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Introduction

The use of online learning is increasingly prevalent in U.S. higher education, and so is the demand (Greenhow et al., 2022; Rusli, 2020). Moore et al. (2011) described online learning "as access to learning experiences via the use of some technology" (p. 130). Most definitions of online learning tend to be broad because technology use in online learning environments can take many forms. As examples, it can be used to facilitate learning that is synchronous or asynchronous; formal or informal; fully online or blended; and adaptive (i.e., individually customized for learners) or static (i.e., the same for every learner; Greenhow et al., 2022). When facilitating asynchronous static learning that is fully online or blended, the use of learning modules is common practice.

Online learning modules are novel resources (Cobb et al., 2018) that enable learners to work at their own pace (Rosenzweig et al., 2017) from any given location (Ghoncheh et al., 2014). They increase the flexibility and accessibility of learning opportunities for many audiences that would otherwise be limited by distance, time availability, or global disasters (e.g., COVID-19 pandemic; Ghoncheh et al., 2014; Kumi-Yeboah et al., 2020). Often, online learning modules are reusable, meaning they "can be used repeatedly and effectively" to fulfill specific learning objectives and achieve various educational purposes (Barritt & Alderman, 2004; Harris et al., 2015, p. 139). Online, reusable learning modules (RLMs) that are self-contained include all content, assessment, and instruction necessary for learners to complete the module without expert instruction. Therefore, RLMs "can effectively deliver quality content not dependent on the level of teachers' mastery of content" (Wolla, 2017, p. 156).

Because their effectiveness does not depend on educators' content mastery, RLMs may be a solution to resolving gaps in agricultural science education. One such gap that scholars and industry employers have drawn attention to in recent years is the number of agricultural students graduating with underdeveloped communications skills (Hendrix & Morrison, 2018; Parrella et al., 2023a; Suvedi et al., 2016), highlighting the need for agricultural science faculty to better develop students' communications skills. This gap is difficult to address, however, because many agricultural science faculty are not communications experts. By integrating communications-focused, online RLMs into agricultural science courses, faculty can provide students with expert training despite their lack of expertise in communications. Such an approach would respond to calls for curricular changes that integrate employability skills training into agricultural science education (Association of Public and Land-Grant Universities 2009; Feldpausch et al. 2019; Parrella et al., 2023a).

Leggette and Murphrey (2017–2020) developed context-specific, communications-focused, online RLMs that can be integrated into postsecondary animal science, poultry science, and plant science courses (Leggette et al., 2020a, 2020b, 2020c; Parrella et al., 2022a). The RLMs are novel because they are free, publicly available, and self-contained (Parrella et al., 2022a). One critical component influencing the effectiveness of RLMs is usability, and the usability of Leggette's and Murphrey's (2017–2020) RLMs has not been assessed. Therefore, our study assessed the usability of three of Leggette's and Murphrey's (2017–2020) RLMs using a wide range of usability metrics. In the following literature review we expand on barriers to undergraduate agricultural students' communications skills development and important considerations for teaching communications skills in online environments.

Literature Review

Barriers to Communications Skills Development

Literature supporting the value of communications skills in the agricultural industry is not lacking (Baker et al., 2022; Corder & Irlbeck, 2018; Crawford et al., 2011; Hendrix & Morrison, 2018; Norris et al., 2019; Parrella et al., 2023a, 2023b; Robinson & Garton, 2008; Wilson et al., 2019), but much of the literature does not provide specific ways to improve students' communication skills across disciplines (Sharma & Sharma, 2010; Tsirkas et al., 2020). In recent years, however, recommendations for integrating communications skills training into technical courses have gained traction (Association of Public and Land-Grant Universities, 2009; Brownell et al., 2013; Feldpausch et al. 2019; Norris et al., 2019; Parrella et al., 2022a, 2022b; Pelger & Nilsson, 2018; Rodgers et al., 2018). Some scholars have recommended such training components be incorporated into existing course curricula (Falkner & Falkner, 2012; Pelger & Nilsson, 2018) while others recommended developing and implementing content-specific communications curricula (Norris et al., 2019; Warren et al., 2007). Either way, the additional workload of creating, teaching, and assessing communications skills curricula represents an increased burden on college and university faculty, which has been documented across disciplines (e.g., Bolliger & Wasilik, 2009; Jaidev & Chan, 2018; Robinson et al., 2017).

Communications skills training at the undergraduate student level is faced with faculty- and student-imposed barriers. Faculty often do not have the time and effort needed to integrate communications instruction into technical course content successfully (Bolliger & Wasilik, 2009; Falkner & Falkner, 2012; Robinson et al., 2017), and large courses make it even more difficult to teach communications skills (Rocklin et al., n.d.). Faculty are often not communications specialists and have skill deficiencies themselves despite the expectations to equip students with communications skills they need to succeed post-graduation. As a result, agricultural science faculty may not feel responsible for developing students' communications skills and, therefore, focus solely on improving their discipline-specific knowledge (Shibley, 2011).

Additionally, students tend to learn and practice communications in their non-science-based courses, as many universities still require students to complete a composition course and a writing-intensive course (Shibley, 2011). However, compartmentalizing skill development in this manner hinders students' ability to apply these skills (Shibley, 2011). Faculty across agricultural disciplines are responsible for helping students learn to communicate as scientists, and many need assistance from expert communicators to provide instruction effectively (Lane & Bogue, 2010; Shibley, 2011). Thus, due to the growing need for students to gain effective communications skills coupled with the stringent demands on faculty time and knowledge gaps, administrators and faculty need to identify more creative and effective ways to offer communications skills training across agricultural curriculum (Doerfert & Miller, 2006). Communications-focused, online RLMs are creative, effective solutions to help address this need (Dubois-Maahs, 2013; Ellman & Schwartz, 2016; Leggette & Murphrey, 2017–2020).

Teaching Communications Skills in an Online Environment

Online instruction, particularly using RLMs, provides a possible solution to this quandary of doing more with less time and knowledge (Yeh et al., 2019). Turnbull et al. (2016) stated that previous reports regarding the effectiveness of communications skills training delivered online have been largely positive. Different modalities of online learning can be used creatively and adaptably for basic and advanced communications skills training (Ellman & Schwartz, 2016). As such, communications skills training has been created and delivered online, specifically through learning modules, to students in many disciplines (e.g., clinical science, leadership, nursing; Dubois-Maahs, 2013; Ellman & Schwartz, 2016; Wittenberg et al., 2021).

To create and deliver effective online instruction, it is important for instructional designers and educators to remember that learner traits and perceptions affect the success and satisfaction of their online learning (Goodwin et al., 2014). According to Alston and English (2007), students who are self-guided learners are more likely than non-self-guided learners to find online instruction useful and beneficial. In addition, online learning self-efficacy influences learner satisfaction and perceived learning in online environments (Alqurashi, 2019) while personality traits also impact their experiences with online learning (Bhagat et al., 2019). For example, learners who are conscientious with higher intellect and imagination have more positive perceptions toward online learning when compared to extrovert, agreeable, and neurotic learners (Bhagat et al., 2019). Learner demographic characteristics (e.g., region, educational level) can also significantly affect online learning success (Rizvi et al., 2019).

Although it is important to consider learner characteristics when developing online communications skills training, online RLMs are often designed for large audiences. Therefore, applying universal design principles should be a priority to increase the accessibility of RLMs for all learners. Mace et al. (1991) described universal design as "an approach to creating environments and products that are usable by all people to the greatest extent possible" (p. 156). The seven universal design principles are 1) equitable use (i.e., design is useful to learners with diverse abilities; 2) flexibility in use (i.e., design accommodates different learning styles and abilities); 3) simple and intuitive use (i.e., design can be understood easily regardless of learner characteristics); 4) perceptible information (i.e., design effectively conveys necessary information to learners); 5) tolerance for error (i.e., design minimizes the adverse consequences of unintended actions); 6) low physical effort (i.e., design can be used efficiently with minimal fatigue); and 7) size and space for approach and use (i.e., design is sized and spaced appropriately for use regardless of learner physicality; Centre for Excellence in Universal Design, 2020). A list of strategies that can be used to achieve the universal design principles can be found on the Centre for Excellence in Universal Design's website.

Course structure also greatly contributes to students' online learning success and satisfaction (Eom & Ashill, 2016). Similarly, Milheim (2012) compared students' need for access to course materials and their ability to navigate a course to the first and second levels of Maslow's hierarchy of needs because, without foundational knowledge, access, and ability, higher levels of thinking and learning are more difficult if not impossible to reach. As Ardito et al. (2006) stated, "the challenge [in creating online learning experiences] is to create an interactive system that doesn't confuse learners" (p. 271). Thus, easy navigation in an online course promotes student interest and interaction (AlHamad et al., 2014). Furthermore, learner/content interaction (Alqurashi, 2019), learner control (Price et al., 2016), and effective written, visual, and animated content (Calli et al., 2013) have all been identified as factors

influencing students' satisfaction and perceived learning in online environments. Learner satisfaction with online learning and ability to access resources are essential for learner engagement and persistence (Chiu et al., 2005; Hart, 2012). Even faculty satisfaction with online learning is impacted by student-related issues, particularly as it relates to difficulty with the technology being used (Bolliger & Wasilik, 2009). Certainly, "a critical component of developing rigorous curriculum is understanding students' experiences and opinions about the curricula" (Norris et al., 2019, p. 65). Thus, we see evaluating the effectiveness and usability of online curriculum as a critical last step in developing effective online curriculum (Barnum et al., 2004; Bartolotta et al., 2017; Carvalho, 2001; Costabile et al., 2005; Dunn et al., 2013).

Conceptual Framework

Our study is framed by the concept of usability. In the context of online learning, usability "refers to the ease of use and operational suitability of the interactive displays and controls that serve as the user interface" (Murphy et al., 1999; Satar & Morshidi, 2007, p. 4). Kumar et al. (2019) wrote that a key element of award-winning online courses was the use of student data (evaluations and outcomes) for continuous improvement. Usability data are one piece of that data set. Identifying usability strengths and weaknesses contributing to learner success or failure in online courses provides valuable guidance for development and improvement of future online courses.

Course developers test the usability of online instruction to detect issues of usability and access; identify interventions to "reduce or eliminate their impact" (Lewis, 2014, p. 664); and ensure the tool, technology, and/or instruction meets learners' needs. Usability testing is a critical step to developing effective online instruction because, as Ardito et al. (2006) wrote, "a poorly designed interface makes students spend more time in learning it than in mastering the provided knowledge, thus becoming a barrier to effective learning" (p. 281). Usability testing for online learning can include many metrics, such as user-friendliness (Kiget et al., 2014), navigation (Ardito et al., 2006; Storey et al., 2002), user satisfaction (Unal & Unal, 2011), compatibility (Chiu et al., 2005), effectiveness (Chen et al., 2021), and learnability (Lund, 2001). Incorporating usability testing into the earlier stages of software development leads to higher quality and more user-friendly products (Calp & Akcayol, 2015). Therefore, "technical issues" (Sahin & Shelley, 2008, p. 220) should be thoroughly addressed prior to use in the classroom.

The usability of online instruction has a strong influence on the success of both the learner and instruction (Liu & Pu, 2020; Yusof & Ahmad, 2012). In 2008, Sahin and Shelley noted distance education students face unique challenges and can be greatly impacted by usability issues. Chiu et al. (2005) discovered that "perceived usability, perceived quality[,] and perceived value had significant effects on satisfaction," strongly predicting "continuance intention" (p. 413). In fact, if users cannot access and move through online instruction efficiently, they may become frustrated and unable to retain information needed to succeed in the program or course (Unal & Unal, 2011). As such, when used properly, usability testing can serve as a framework to increase rigor and relevancy of online learning. In the current study, the usability metrics we collected were RLM training effectiveness (i.e., confidence and knowledge gains), navigation, video function, document access and readability, quiz and assignment practicality, and task difficulty.

Purpose

We sought to examine the usability of three online RLMs in agricultural science communications to identify usability issues and provide guidance for future development of online instruction focused on communications skills development. Our objective was to use RLMs with the target audience to identify usability issues that would mitigate effective instruction. Four research questions guided the study:

1. How did participants rate their ability to perform communications skills?
2. How did participants' confidence in performing communications skills change as a result of completing the online RLMs?
3. How did participants' communications skills knowledge change as a result of completing the online RLMs?
4. What were participants' perceptions of and experiences with the online RLM features?

Methods

Similar to Barnum et al. (2004), Dunn et al. (2013), and Rhoades et al. (2007) who used usability testing methods to assess the usability of online interfaces, we used quantitative and qualitative data sources to assess the usability of communications-focused RLMs. We quantitatively assessed students' perceived ability to perform the communications skills of focus in the online RLMs because we wanted to understand their perceived skill levels prior to their completion of the RLMs. We also quantitatively assessed students' confidence in performing communications skills before and after completing the online RLMs; students' knowledge of communications skills before and after completing the online RLMs; and students' perceptions of and experiences with online RLM features. We qualitatively recorded observations of students while they completed the online RLMs and conducted qualitative follow-up interviews with students to gather their suggestions for online RLM improvement.

Online RLMs Tested for Usability

The three RLMs we tested focused on three of the seven communications competencies Crawford et al. identified in 2011: "communicating accurately and concisely" (Leggette et al., 2020a), "communicating appropriately and professionally using social media" (Leggette et al., 2020b), and "communicating orally" (Leggette et al., 2020c). The learning outcomes associated with each RLM can be found in Table 1. The RLMs were created by Leggette and Murphrey—experts in agricultural communications, adult education, and online learning—as part of a 2017–2020 National Institute of Food and Agriculture Higher Education Challenge Grant. Even though Crawford et al. identified the communications competencies in 2011, they are still often used as a benchmark for the general communications skills agricultural students need upon entry into the workforce (e.g., Norris et al., 2019; Parrella et al., 2023b; Wickenhauser et al., 2020).

Table 1

Learning Outcomes Associated with Each RLM Tested for Usability

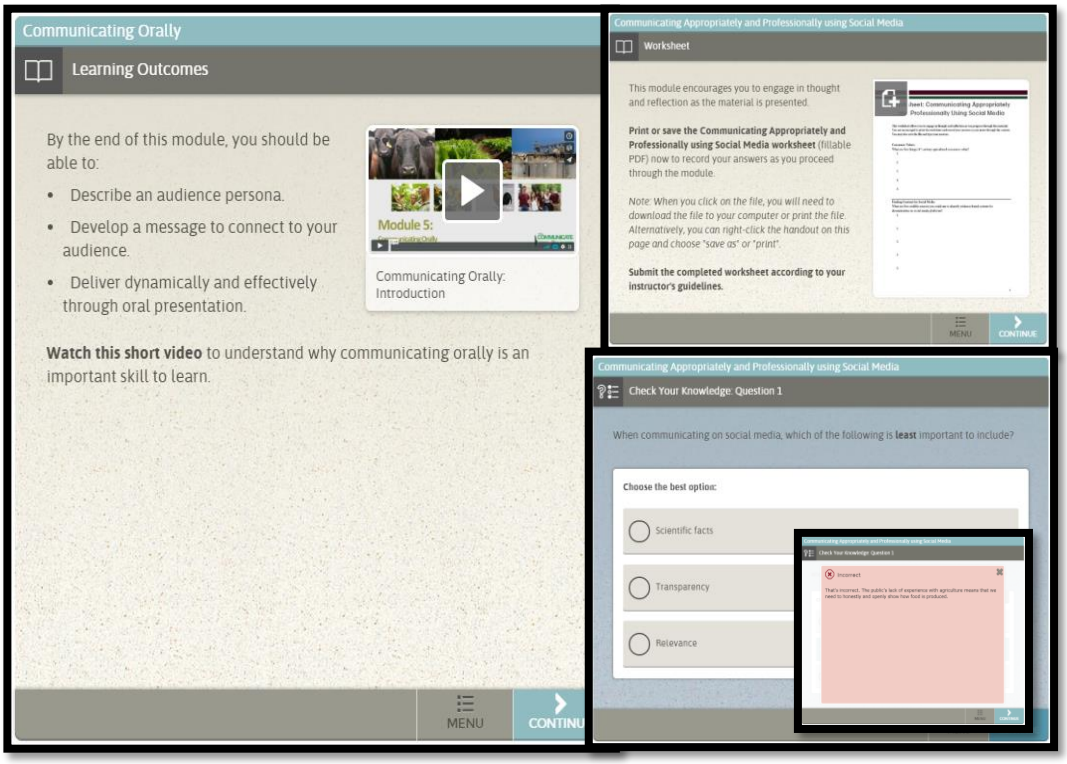
Communicating Accurately and Concisely
1. Interpret scientific, evidence-based arguments for a general, non-scientific audience. 2. Communicate accurate and concise information for publication in popular press mediums.
Communicating Appropriately and Professionally using Social Media
1. Identify agricultural brands that have effectively positioned themselves in the digital environment. 2. Develop scientific, evidence-based information for delivery on social media platforms. 3. Defend agricultural issues on social media platforms using evidence-based arguments. 4. Analyze agricultural issue arguments on social media platforms and provide evidence-based information to support or refute the arguments.
Communicating Orally
1. Describe an audience persona. 2. Develop a message to connect to their audience. 3. Deliver dynamically and effectively through oral presentation.

The RLMs are "Sharable Content Object Reference Model" (SCORM) compliant and compatible with multiple learning management systems (LMSs). For the current study, we tested each RLM for usability in an LMS provided by Texas A&M University. The RLMs are designed to be context-specific (animal, plant, and poultry sciences) because context-specific communications curriculum is lacking in the agricultural sciences, and these three science disciplines are three primary areas of food production. Regardless of topic focus, each module included examples and scenarios from all three sciences.

The RLMs include videos, embedded PDF documents, quiz questions, links to other assessments and resources, worksheets in PDF format, and images. Some examples are shown in Figure 1. Videos are hosted by YouTube™ or Vimeo™ and describe topics in further detail. All Vimeo™ videos (created by content authors) have closed-captioning available for viewers. Embedded PDF documents are used to expand concepts and, like the videos, include a mix of created (original material created by project authors) and curated (material created by third party authors) content. Third party author permission was received prior to using curated content. In addition to providing individual documents throughout the instruction, a *Student Resource Packet*—a collection of all documents needed to complete each RLM—is included at the beginning of the RLM for user convenience. Supplemental resources are also included via hyperlinks throughout the instructional text. Users are not required to read hyperlinked information, but they can use these links to obtain more information as desired.

Figure 1

Screen Captures of RLM Content and Interactivity



Sample

We recruited participants by posting an informational flyer in undergraduate advisors' offices and by sending an informational recruitment email via Texas A&M University course instructors. Promotional materials directed students to sign up using a link to SignUpGenius.com, and all who signed up followed through with participation. Virzi (1992) determined "80% of usability problems are detected with four or five subjects," yet Davids et al. (2015) recommended "10 participants to detect 80% of the serious usability problems" (p. 1051) in online learning modules. Therefore, seven participants completed each RLM (N = 21) while we observed their learning and progress. Two of these participants failed to complete one of the survey instruments: usability test survey was not completed by S17M03 and RLM score was not collected from S04M05. Thus, 20 participants completed the usability test instrument, 20 participants completed the in-module quiz, and 21 participants completed the self-assessment instrument and pre- and post-assessment instruments.

Of 21 participants, 57% (f = 12) were female, and 42% (f = 9) were male. The majority (62%, f = 13) were aged 21–30, with 33% (f = 7) between 18–20 and one between 31–40 years old. Sixty-four percent identified as White/Caucasian (f = 13), 24% as Hispanic or Latino (f = 5), and 14% as Black or African American (f = 3). Fifty-two percent were classified as seniors (f = 11), 28% were juniors (f = 6), and 14% were sophomores (f = 3). One participant did not share

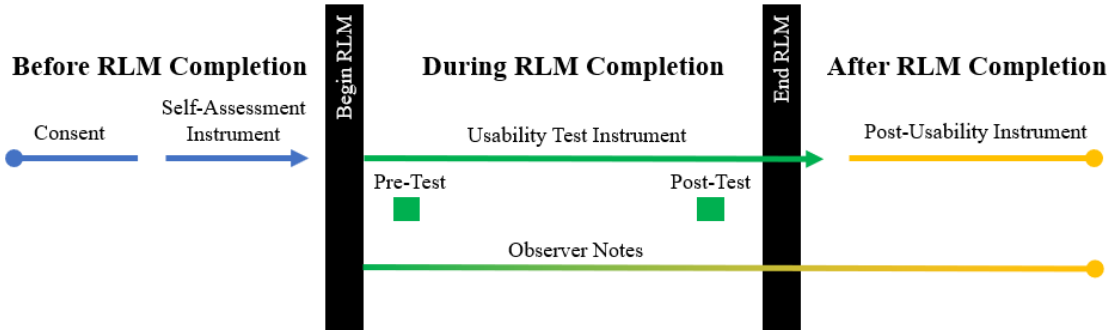
classification. Participants represented a variety of departments and were pursuing both agricultural- and non-agricultural-related degrees.

Data Collection

Data collection occurred before, during, and after RLM completion using five unique instruments and researcher observation, as demonstrated in Figure 2.

Figure 2

Data Collection Process for each RLM



Prior to scheduled testing, participants received an email reminder of their appointment, which included the time and location of their appointment. All testing took place on campus in the office of one of the authors. Once participants arrived, they received information about the study, signed a consent form to participate, and received a code number. Codes were based on order of completion and module completed (e.g., S01M02: Student 1, completing Module 2) and were used to track participants across instruments.

Participants completed five instruments while completing the RLM. First, we provided participants access to a computer with two monitors, and they completed the self-assessment instrument. Next, we directed the participants to open the usability test instrument on one monitor so that they could complete parts of the instrument before, during, and after completing the RLM. On the second monitor, the participant accessed the RLM within a learning management system. As participants worked through the RLM, they also completed a pre-test and post-test about their knowledge specific to the RLM content, worksheets included in the RLM learning activities, and quiz questions embedded within the RLM. Finally, participants completed and submitted the usability test instrument after completing the RLM.

Participants completed the post-usability instrument immediately following submission of the usability test instrument. The author facilitating data collection observed completion of the RLM, recorded observation notes, and visited with the participant following RLM completion. This interview, which lasted approximately 20 minutes, allowed clarification of observations and collection of auditory feedback from participants. We collected data using Qualtrics for both the surveys and knowledge assessments, and we typed and coded observation notes in preparation for analysis. As an incentive, we provided a $10 gift card to all participants who completed the study.

Instruments

We developed five Qualtrics instruments: self-assessment, pre- and post-test, usability test, and post-usability. We established content and face validity of the instruments through an expert panel review. Experts were faculty and graduate students in the [College] who have taught communications skills courses and were actively involved in developing and testing communications skills curriculum.

Self-Assessment Instrument

Before participants completed the RLMs, we asked them to provide demographic information. We also asked them to rank their ability to perform Crawford et al.'s (2011) communications characteristics—listening effectively, communicating accurately and concisely, communicating orally, communicating pleasantly and professionally, communicating in writing, asking effective questions, and communicating appropriately and professionally using social media—using a Likert-type scale of 1 (*low ability*) to 5 (*high ability*). These seven communications characteristic areas reflected the seven RLMs created for the now-complete USDA Higher Education program. The RLMs being tested focused on three of the seven areas.

Pre- and Post-Test Instruments

The pre- and post-test instruments contained topic-specific multiple-choice and true/false questions: "Communicating Accurately and Concisely" contained 17 questions, "Communicating Appropriately and Professionally Using Social Media" contained 15 questions, and "Oral Communication" contained 14 questions. These questions were designed to measure change in knowledge about the communication topic and were unique for each RLM. The pre- and post-test instruments also asked participants to rate their confidence to perform the respective communications skill on a five-point Likert-type scale. We embedded links to these two instruments in the beginning and end of the RLMs, allowing participants to complete them at the beginning and end of the RLM. Participants took an average of 30 minutes to complete the pre-test and average of 27 minutes to complete the post-test. All participants completed both instruments.

Usability Test

The usability test portion had three components: RLM completion (resulting in a score) while simultaneously completing the usability test (usability score) and researcher observation of completion. To obtain a RLM score, module developers embedded formative assessments (i.e., "Check Your Knowledge" quiz questions) into each RLM to target and measure achievement and learning. The formative "Check Your Knowledge" questions assessed understanding of the RLM content and generated a score of 1 to 100.

The usability instrument first collected information regarding how the participant accessed the RLM (i.e., the browser selected), start time, and RLM name. Next, participants typed notes about their experience working through the module. After completing the RLM, participants answered questions about navigation, content, videos, documents, questions, and worksheets via a 5-point Likert scale (*strongly disagree* to *strongly agree*). The survey ended

with the participants providing a stop time, their college classification (e.g., freshman, sophomore), major, and suggestions for improvement.

In addition, the lead author of the study observed the usability test and took notes while participants worked through the RLMs. Observation notes focused on navigation and access because navigation, the user's ability to locate and use features of the instruction, is a top priority for usability testing and can heavily influence the user's perceptions of the online instruction (Storey et al., 2002). Additionally, the observer documented participants' ability to access course components (i.e., videos, documents, hyperlinked material) and complete assignments as they became available. They also noted issues experienced with navigation, access, and participants' comments about the assignments. Twenty participants (all but S17M03) completed the usability instrument. Participants completed the RLMs in an average of 1 hour and 24 minutes using a Google Chrome (n = 10), Mozilla Firefox (n = 3), Internet Explorer (n = 6), or unknown (n = 2) browser.

Post-Usability Instrument

The post-usability instrument, which participants completed immediately after completing the usability instrument, gathered feedback about task difficulty, technology acceptance attitudes, and overall opinions of the RLM completed. We assessed task difficulty using six statements scored on a Likert-type scale of 1 (*difficult*) to 5 (*easy*), technology acceptance using four statements scored on a Likert scale of 1 (*strongly disagree*) to 7 (*strongly agree*), and overall opinions using one statement on a Likert-type scale of 1 (*very negative*) to 7 (*very positive*). After participants completed all instruments related to usability testing, they had brief conversations with the lead author to review issues experienced with the RLM and discuss overall experiences with the online instruction.

Data Analysis

We calculated descriptive statistics for the quantitative data using Microsoft Excel. For the qualitative data, we coded all open-ended participant responses, interview findings, and observation notes by categorizing them into themes. We then triangulated findings present in the open-ended responses with the interview/observation notes. The constant-comparative method and open coding procedures allowed us to immerse ourselves in the data and resulted in rich descriptions of participant experiences (Glaser, 1965).

Results and Findings

How did Participants Rate their Ability to Perform Communications Skills?

Prior to beginning the module, participants (N = 21) rated their ability to perform each of Crawford et al.'s (2011) seven communications skills (i.e., listening effectively, communicating pleasantly and professionally, communicating in writing, communicating orally, communicating accurately and concisely, asking effective questions, communicating appropriately and professionally using social media). Most participants perceived they had moderate to high ability to perform each skill (see Table 2).

Table 2

Participants' Perceived Ability to Perform Communications Skills

Communications Skill	Ability Level									
	HA (5)		4		3		2		LA (1)	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Listening Effectively	8	38.1	8	38.1	5	23.81	0	0	0	0
Communicating in Writing	8	38.1	6	28.57	4	19.05	3	14.29	0	0
Communicating Pleasantly and Professionally	5	23.81	14	66.67	1	4.76	1	4.76	0	0
Asking Effective Questions	5	23.81	7	33.33	9	42.86	0	0	0	0
Communicating Orally	3	14.29	14	66.67	3	14.29	1	4.76	0	0
Communicating Accurately and Concisely	3	14.29	13	61.9	4	19.05	1	4.76	0	0
Communicating Appropriately and Professionally Using Social Media	3	14.29	6	28.57	9	42.86	2	9.52	1	4.76

Note. HA = High Ability; LA = Low Ability.

How did Participants' Confidence in Performing Communications Skills Change as a Result of Completing the Online RLMs?

Pre- and post-tests measured participants' confidence in their ability to perform the communication skill(s) measured by the RLM (see Table 3). The communicating accurately and concisely RLM was broken into two constructs: accurately and concisely. Participants demonstrated an increase in their confidence to perform each of the communications skills after completing the module. Participants felt most confident in their ability to communicate orally (based on the pre-test) and demonstrated the highest change in confidence in their ability to communicate orally (based on the post-test).

Table 3

Participants' Pre- and Post-Test Scores Representing Confidence in their Ability to Perform Communication Skills Measured by the RLM

Communications Skill	Pre-Test		Post-Test		Average Change in Mean
	M	*SD*	*M*	*SD*	
Communicating Orally	7.14	0.55	8.33	0.33	+1.19
Communicating Appropriately and Professionally Using Social Media	6.86	0.86	8.00	0.49	+1.14
Communicating Accurately	6.57	0.72	7.43	0.37	+0.86
Communicating Concisely	5.43	0.92	6.43	1.00	+1.00

Note. Responses were measured using a 10-point scale (0 = *extremely inadequate* to 10 = *extremely adequate*).

How did Students' Communications Skills Knowledge Change as a Result of Completing the Online RLMs?

We compared participant scores for the pre- and post-test instruments to measure changes in knowledge as a result of completing their specific RLM (n = 20; see Table 4). The oral communication RLM had the greatest increase in post-test scores. The accurate and concise communication RLM had the smallest increase in post-test scores despite having the highest average pre-test score. Participants had a positive change in scores after completing each RLM, indicating a general knowledge increase as a result of the curriculum. Participants had the highest post-test score on the oral communication RLM and the lowest post-test scores on the accurate and concise communication RLM.

Table 4

Participants' Pre- and Post-Test Score Comparisons Representing Knowledge Change of the Communications Skills Measured by the RLM

Module Title/Topic	Pre-Test Average Score	Post-Test Average Score	Average Change in Score
Communicating Accurately and Concisely	73.95	74.79	+0.84
Communicating Appropriately and Professionally using Social Media	56.19	81.90	+25.71
Communicating Orally	67.35	90.48	+26.19
3-Module Average	65.83	81.99	+16.16

Note. The pre- and post-tests used a 0–100 range. One participant (S04M05) did not submit their module and therefore did not receive a score.

Scores collected by the LMS also reflected lower scores from the accurate and concise communication RLM. These scores were based on participants' answers to "Check Your Knowledge" questions (formative assessment) used throughout each RLM. The average scores out of a possible 100 were 68 for communicating accurately and concisely; 81.03 for communicating appropriately and professionally using social media, and 96.97 for communicating orally.

What were Participants' Perceptions of and Experiences with the Online RLM Features?

Navigation

Participants rated the ease or difficulty of navigating the module and opening content as *easy* (f = 10; 50%) or *moderately easy* (f = 10; 50%). However, when reviewing participants' comments, we found that seven participants (35%) reported difficulty with navigation and five

participants (24%) reported being unable to review previous content. We designed the modules to allow users to move only forward; therefore, these five complaints do not represent a flaw in the program. However, we noted the preference for the ability to review information for future iterations. Finally, participants completing the social media module found that opening hyperlinks mistakenly logged them out of the LMS, which we noted as valuable feedback for module development.

Video

Participants (*n* = 20) ranked the usability and content of videos with four statements on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*; see Table 5). Most participants *strongly agreed* or *agreed* that videos opened and played without technical issues (*f* = 16; 80%); video sound worked correctly and was easy to understand (*n* = 19; *f* = 17; 89.48%); video content was useful and helped me understand the content (*f* = 18; 90%); and videos were visually appealing (*f* = 17; 75%). Two participants used the video caption feature, which confirmed it worked properly; two found the videos boring (S12M02) or dull (S20M03); and two reported quality or glitching issues with YouTube-hosted videos in the oral communication RLM (S21M05, S07M05). During the interview, most participants noted they enjoyed the videos even though the video length was not optimal. Some liked the video length, but others preferred longer videos and preferred videos over reading (S18M02).

Table 5

Usability of Module Videos as Reported by Participants

Video Criteria	Level of Agreement									
	SA		A		NAD		D		SD	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Videos opened and played without technical issues.	13	65	3	15	3	15	1	5	0	0
Videos' audio worked correctly and was easy to understand. (*n* = 19)	12	63.16	5	26.32	1	5.26	1	5.26	0	0
Content of videos was useful and helped me understand the content.	8	40	10	50	1	5	1	5	0	0
Videos were visually appealing.	6	20	11	55	2	10	1	5	0	0

Note. SA = Strongly Agree; A = Agree; NAD = Neither Agree nor Disagree; D = Disagree; SD = Strongly Disagree.

Documents

Participants (*n* = 19) shared their impressions of the RLM documents based on their agreement with seven statements on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*; see Table 6). One participant (S17M03) did not submit a usability survey and, therefore,

was not included. Most participants *strongly agreed* or *agreed* that they would read the documents if they were taking the course for credit (*f* = 18; 94.73%), that documents were beneficial resources (*f* = 18; 94.73%), that documents were visually appealing (*f* = 16; 84.21%), that documents were useful and helped them understand the content (*f* = 17; 89.47%), and that documents opened and saved correctly (*f* = 16; 88.89%). Most participants *strongly disagreed* or *disagreed* that documents were too long (*f* = 10; 52.64%). However, during the interview, participants, particularly those completing the accurate and concise communications RLM (S01M02, S10M03, S11M02, S12M02, S16M02), reported the documents to be too long. They suggested that an overview of long documents be provided to indicate how and where learners should focus their reading.

Table 6

Usability of Module Documents as Reported by Participants

Document Criteria	Level of Agreement									
	SA		A		NAD		D		SD	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
I would read the documents if I were taking this course for credit.	11	57.89	7	36.84	1	5.26	0	0	0	0
The documents are a beneficial resource for students.	10	52.63	8	42.11	1	5.26	0	0	0	0
The documents were visually appealing.	9	47.37	7	36.84	3	13.79	0	0	0	0
The documents' content was useful and helped me understand the content.	7	36.84	10	52.63	2	10.53	0	0	0	0
The documents opened and saved correctly. (*n* = 18)	7	38.89	9	50	1	5.56	1	5.56	0	0
I was able to go back and find documents from earlier in the module if needed. (*n* = 16)	4	25	5	31.25	3	18.75	2	12.5	2	12.5
The documents were too long or took too long to read.	3	15.79	4	21.05	2	10.53	8	42.11	2	10.53

Note. SA = Strongly Agree; A = Agree; NAD = Neither Agree nor Disagree; D = Disagree; SD = Strongly Disagree.

Quiz Questions

Participants (*n* = 20) responded to questions pertaining to quizzes on a 5-point Likert-type scale (1 = *strongly disagree* to 5 = *strongly agree*; see Table 7). Most participants *strongly agreed* or *agreed* that feedback given with answer choices was useful (*f* = 16; 80%) and that in-

module questions helped solidify information covered in the RLM (*f* = 19; 95%). Most participants *strongly disagreed* or *disagreed* that there were too many questions (*f* = 17; 85%) and that questions were too difficult (*f* = 19; 95%). Three participants suggested more questions be added to the quizzes. Interviews revealed a handful of users believed questions were asked before the answer to the question was shared (S03M03, S10M03, S12M02), making selecting the correct answer more difficult. Participants valued built-in answer feedback even if they were unable to select another answer.

Table 7

Usability of Module Quizzes as Reported by Participants

Quiz Criteria	Level of Agreement									
	SA		A		NAD		D		SD	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
The feedback given with answer choices was useful.	11	55	5	25	3	15	1	5	0	0
The questions helped to solidify information that was covered in the module.	10	50	9	45	0	0	0	0	1	5
There were too few questions in the module.	0	0	7	35	3	15	9	45	1	5
Questions were too easy.	0	0	5	25	7	35	6	30	2	10
There were too many questions in the module.	0	0	1	5	2	10	13	65	4	20
Questions were too difficult.	0	0	0	0	1	5	11	55	8	40

Note. SA = Strongly Agree; A = Agree; NAD = Neither Agree nor Disagree; D = Disagree; SD = Strongly Disagree.

Worksheets, Presentations, and Other Assignments

Participants (*n* = 18) shared their impressions of the RLM assignments based on their agreement with nine statements on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*; see Table 8). Most participants *strongly agreed* or *agreed* that the assignments helped them apply principles learned in the module (*f* = 15; 83.33%), that the assignments related to the content of the module (*f* = 17; 94.44%), that they understood how to submit assignments (*f* = 14; 77.78%), and that the materials were clear and visually pleasing (*f* = 15; 83.33%). In addition, most participants *strongly disagreed* or *disagreed* that the assignments were too long (*f* = 10; 58.82%). One participant (S17M03) did not submit a usability survey, and two participants did not participate in this part of the study because their RLM did not contain additional assignments. Some participants completed worksheets using a fillable PDF option while others printed the worksheets and completed them in handwriting.

Table 8

Usability of Module Assignments as Reported by Participants

Assignment Criteria	Level of Agreement									
	SA		A		NAD		D		SD	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
The assignments helped me apply the principles I learned in the module.	7	38.89	8	44.44	3	16.67	0	0	0	0
The assignments related to the content of the module.	6	33.33	11	61.11	1	5.56	0	0	0	0
I understood how to submit the assignments.	6	33.33	8	44.44	3	16.67	1	5.56	0	0
The materials provided for the assignments were clear and visually appealing.	4	22.22	11	61.11	1	5.56	2	11.11	0	0
I understood how to complete the assignments.	4	22.22	10	55.56	1	5.56	3	16.67	0	0
I could easily access the materials I needed to complete the assignments. (*n* = 17)	4	23.53	8	47.06	2	11.76	3	17.65	0	0
I enjoyed completing the assignments. (*n* = 17)	3	17.65	4	23.53	8	47.06	1	5.88	1	5.88
The assignments related to my field/major. (*n* = 16)	2	12.5	3	18.75	5	31.25	2	12.5	4	25
The assignments took too long to complete. (*n* = 17)	1	5.88	3	17.65	3	17.65	9	52.94	1	5.88

Note. SA = Strongly Agree; A = Agree; NAD = Neither Agree nor Disagree; D = Disagree; SD = Strongly Disagree.

Impressions and Suggestions

Participants (*n* = 20) rated their overall usability of the RLM based on their agreement with nine statements on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*; see Table 9). Most participants *strongly agreed* or *agreed* that the type of instruction provided in the module would be useful to them in the workforce (*f* = 15; 78.95%) and during college (*f* = 16; 80%), that the module explained concepts clearly (*f* = 19; 95%), that they understand communication better after completing the module (*f* = 17; 85%), that the module was visually appealing and easy to navigate (*f* = 18; 90%), and that the module would be a helpful addition to

their major's coursework (*f* = 14; 70%). Most participants *strongly disagreed* or *disagreed* that the module was overwhelming (*f* = 16; 80%) and that it took too long to complete (*f* = 11; 55%).

Table 9

Overall Usability of the Module as Reported by Participants

Module Criteria	Level of Agreement									
	SA		A		NAD		D		SD	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
This type of instruction would be useful to me in the workforce. (*n* = 19)	9	47.37	6	31.58	2	10.53	2	10.53	0	0
The module explained concepts clearly.	8	40	11	55	1	5	0	0	0	0
I have a better understanding of this type of communication now.	8	40	9	45	3	15	0	0	0	0
This type of instruction would be useful to me during college.	7	35	9	45	4	20	0	0	0	0
This module was visually pleasing and easy to navigate.	5	25	13	65	2	10	0	0	0	0
Faculty in my department would use this module in their coursework. (*n* = 18)	5	27.78	4	22.22	4	22.22	5	27.78	0	0
This module would be a helpful addition to my major's coursework.	4	20	10	50	4	20	2	10	0	0
This module took too long to complete.	1	5	4	20	4	20	10	50	1	5
The module was overwhelming.	1	5	2	10	1	15	13	65	3	15

Note. SA = Strongly Agree; A = Agree; NAD = Neither Agree nor Disagree; D = Disagree; SD = Strongly Disagree.

Post-Usability Assessment of Reusable Learning Modules

On a 7-point Likert-type scale (1 = *very negative* to 7 = *very positive*), participants (*n* = 21) provided their overall opinions of the RLMs (see Table 10). All participants had at least a somewhat positive opinion (somewhat positive (*f* = 6; 29%), positive (*f* = 11; 52%), and very positive (*f* = 1; 5%)). For all RLMs, participants (*n* = 21) rated their level of task difficulty associated with completing the modules on a 5-point scale (1 = *difficult* to 5 = *easy*; see Table 9). Most, if not all participants, believed each task was *easy* or *somewhat easy*.

Table 10

Level of Module Task Difficulty as Reported by Participants

Module Task	Level of Difficulty									
	Easy		SE		Neutral		SD		Difficult	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Completing the quizzes.	20	95.24	1	4.76	0	0	0	0	0	0
Viewing the images on screen.	19	90.48	2	9.52	0	0	0	0	0	0
Watching videos.	19	90.48	0	0	2	9.52	0	0	0	0
Reading the text provided on the screen.	17	80.95	4	19.05	0	0	0	0	0	0
Following on-screen directions.	17	80.95	3	14.29	1	4.76	0	0	0	0
Accessing and utilizing the worksheets. (*n* = 20)	13	65	4	20	2	10	1	5	0	0
Navigating the modules.	11	52.38	8	38.1	2	9.52	0	0	0	0

Note. SE = Somewhat Easy; SD = Somewhat Difficult.

Post-Usability Testing Experience Interviews

During the interviews, participants provided suggestions for worksheets, documents, quiz questions, videos, pre- and post-quiz questions, and module content. Participants expressed need for more instruction on how to navigate and use module components and more direction on identifying the most important parts of long PDF documents as mentioned earlier. Participants generally liked video components and found the content useful, though non-agriculture majors would have benefited from additional context describing the agricultural examples.

Conclusions and Recommendations

Although field-specific knowledge and skills are understandably the focus of agricultural science education, employers strongly value communications skills (Crawford et al., 2011; Robinson & Garton, 2008). Students who fill industry and academic positions in agriculture need to learn to communicate effectively with stakeholders in their respective fields. Using communications-focused, online RLMs may enable agricultural science faculty to provide students with expert training despite their lack of expertise in communications. Thus, assessing the usability of these online RLMs permit consistent and timely communications skills training.

Participants' felt confident in their ability to perform communications skills. These results are similar to those of Norris et al. (2019) and Parrella et al. (2023b). However, because participants' perceptions of their communications skills may be inflated and not accurately reflect their skill levels (Parrella et al., 2023a), formal communications training integrated into agricultural science courses is important (Lane & Bogue, 2010). After completing the module, participants reported an increase in their confidence to perform and an increase in their knowledge of the communications skills. Training effectiveness and learnability are important

usability metrics (Chen et al., 2021; Lund, 2001); therefore, participants' increase in confidence and knowledge positively demonstrate module usability and indicate an overall positive experience.

Participants reported that the module content was relevant and useful, suggesting they perceived it valuable. Regarding content delivery, participants liked the videos, quizzes, assignments, and depth of content. The short videos and quizzes increased learner interaction with the content and provided a respite from text-based instruction. Participants suggested some areas to improve these videos and quiz questions as well as additional details for written assignments and guidance for navigation. Nearly a third of participants reported some difficulty with navigation, and a quarter of participants wanted access to previous content. The importance of navigation in online learning (Ardito et al., 2006; Storey et al., 2002; Unal & Unal, 2011) emphasizes the need for this area to be improved. Participants also noted that one major area of improvement needed was including an overview of documents' key points to guide reading.

Overall, the modules garnered high usability scores from participants who had positive impressions and experiences completing the modules and module tasks. We believe these RLMs provide excellent opportunities for students to receive expert communications skills training as part of their agricultural sciences courses. Participants demonstrated a readiness and willingness to engage with the RLMs, which supports the need and opportunity to deliver communications skills training online. Their readiness and willingness to engage also supports the idea that communications-focused RLMs is a solution to resolving gaps in agricultural science education, specifically by decreasing the number of agricultural students graduating with underdeveloped communications skills (Hendrix & Morrison, 2018; Parrella et al., 2023a; Suvedi et al., 2016).

Recommendations for Practice

Our intensive usability testing revealed important elements to guide the development of online RLMs, especially those focusing on communications skills training. Although some aspects of developing effective online instruction (e.g., providing captions with all videos) are requirements to meet accessibility needs (Centre for Excellence in Universal Design, 2020), maintaining flexibility in how students use and learn with RLMs can influence how instruction is received. For example, captioning is best when it can be toggled on and off as the text can be distracting to some students.

Our results and findings suggest content developers should consider including short video units, printable handouts to support content, and embedded quizzes. Participants indicated a desire to advance through content with flexibility to return to previous information for detailed feedback on assignments and quizzes, and for an overview to accompany longer documents. We recommend instruction be structured to challenge students to engage cognitively and to re-visit content they might have misunderstood.

Similarly, navigation is a topic all instructional designers and course developers should consider carefully. Early, frequent, and clear guidance related to navigation should be provided to ensure students do not spend time confused by what might happen next (e.g., will I be able to go back?) or how to complete a request (e.g., where do I submit my response?). Instructions should be provided to show users how to move within the module; how to interact with text, videos, and documents; and how to meet requirements for a module to be considered "complete."

Regarding participant feedback, our study supports previous literature that indicates students desire detailed feedback on assignments and quizzes (Milheim, 2012). We recommend

additional feedback be implemented to reinforce critical concepts. Although we are not surprised participants hesitated to read long articles, we recommend video guides rather than written summaries to introduce long readings. The video can further engage the learner and help them see the importance of the reading.

We recommend more agricultural communicators partner with instructional designers and intentionally adhere to instructional design frameworks (e.g., Quality Matters) to develop and assess the usability of RLMs focused on developing other communications skills. The RLMs tested for usability in the current study focus on developing agricultural science students' general communications skills. Because of participants' positive feedback regarding RLM usability, we believe the implementation of these RLMs, and others that could be developed to focus on more advanced communications skills (e.g., building trust with audiences, using effective storytelling tools to engage audiences; implementing risk communication principles), may help agricultural students develop into dynamic science communicators.

Recommendations for Research

Communicating is a behavior; thus, measuring learning through assessment quizzes is not the most desirable form of measurement. We recommend conducting observational research to measure change in behavior of students who have and have not used RLMs because behavior change is necessary to improve communications skills. Further, longitudinal research should be conducted to determine the impact of RLM use beyond the college classroom. The ultimate goal of creating, assessing, and implementing the RLMs is to improve students' communications skills and enhance their workforce readiness. Therefore, it is critical to evaluate if the knowledge and skills students gain from completing the modules have long-term and lasting effects.

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