The Journal of Extension

Volume 62 | Number 3 Article 30

9-15-2024

OLAF: An Assessment of Online Learning Outcomes Among Forestry and Natural Resource Management University Students

Krista Merry
University of Georgia, kmerry@warnell.uga.edu

Pete Bettinger
University of Georgia, pbettinger@warnell.uga.edu

Taeyoon Lee
University of Georgia, taeyoon.lee@uga.edu

Recommended Citation

Merry, K., Bettinger, P., & Lee, T. (2024). OLAF: An Assessment of Online Learning Outcomes Among Forestry and Natural Resource Management University Students. *The Journal of Extension, 62*(3), Article 30. https://open.clemson.edu/joe/vol62/iss3/30

JOURNAL OF Extension

Feature Article

Volume 62, Issue 3, 2024

OLAF: An Assessment of Online Learning Outcomes Among Forestry and Natural Resource Management University Students

Krista Merry[1], Pete Bettinger[1], and Taeyoon Lee[1]

AUTHORS: [1]University of Georgia.

Abstract. Online learning has become an important advance in education in the last decade. We developed an online learning system related to land and tree measurements. University students were given pre- and post-exposure surveys for two courses offered within the online system. Surveys were designed to assess whether the knowledge level and confidence of students increased through interaction with the online system. A final assessment was conducted to understand user experiences with the online technology. Statistically significant increases in knowledge and confidence concerning land measurement concepts and tree measurement topics were evident among survey participants. Survey participants agreed that the course functioned properly, that graphics and images within the courses were useful, and that using the system prior to in-person instruction helped students better understand concepts.

INTRODUCTION

Since the twenty-first century began, increased focus and attention have been directed toward the development of online education portals in higher-education environments (Otter et al., 2013). Further, current university students have grown up in an age where they have some expectation of online access being included in their curriculum and where they consult the Internet first when seeking information about a subject (Barclay et al., 2018; Ni, 2013). The COVID-19 pandemic, beginning in 2020, further emphasized a need for remote, online instruction (Chick et al., 2020). However, preferences for the ideal educational environments vary from one person to the next, potentially affecting the adoption of online instruction platforms (Hussein & Hilmi, 2021). Some people may prefer in-person, face-to-face instruction and therefore may be hesitant to embrace online learning environments. This hesitation could be the result of a person needing instant feedback provided by instructors, which is most available during in-person instruction (Zhang et al., 2004), or it may be the result of general frustration with working or otherwise engaging with coursework online (Otter et al., 2013). On the other hand, some people may prefer online instruction, valuing the ease and flexibility of remote access to an online learning environment, where travel to a classroom is generally avoided and only a stable Internet connection for a phone or laptop is required to connect with the coursework online (Appana, 2008; Cantrell et al., 2008; Ni, 2013; Zhang et al., 2004).

Although the methods for online instruction can facilitate access to coursework by people through remote connections, online learning systems are only successful if people choose to use them correctly (Pituch & Lee, 2006). The likelihood of the adoption of new technologies, such as online learning platforms, is often evaluated through two points of discussion. The first point is that people may be more likely to adopt technology if it is viewed as valuable in terms of enhancing a person's ability to improve their knowledge in a subject area. The second point is that people may be more likely to adopt technology if it is viewed as easy to use, with minimal difficulty experienced (Yi & Hwang, 2003). A successful online learning platform would therefore need to be readily and easily available and need to address important knowledge requirements of a community of users, who may include students, practicing professionals, and the public (Daultani et al., 2021; Pituch & Lee, 2006). The success of online educational tools can be assessed through various metrics, including user satisfaction, system functionality (including performance), and the knowledge gained by people who have participated within the online platform

(Aparicio et al., 2019). With this information in mind, our focus was to evaluate the effectiveness of two online courses through students' reflection or self-assessment of their own knowledge and confidence gains and to further receive feedback regarding potential system improvements.

The Online Learning in Applied Forestry (OLAF) educational tool is an asynchronous set of online courses developed to aid in understanding concepts associated with land and forest resources, including collecting and analyzing information about these resources. The content of the OLAF education tool is based on the instructional book *Handbook of Land and Tree Measurements* (Bettinger et al., 2019), used by third-year students enrolled in a course offered at the University of Georgia, Forestry and Natural Resources (FANR) 3000: Field Orientation, Measurements, and Sampling in Forestry and Natural Resources. In total, OLAF consists of 10 self-paced courses (see Table 1) developed by using the learning management system LearnDash (2022) within a WordPress environment. Each course in OLAF is self-paced, with forward and backward navigation, and each course is composed of multiple topics that often include illustrated examples. Predominantly, OLAF course instruction is text-based, as opposed to video-based, often referencing the present science associated with a course topic.

Where appropriate, hyperlinks to resources available (i.e., videos, publications, or reports) outside the learning tool are provided. Additionally, low-stakes practice quizzes are distributed throughout each course, and each course concludes with a 25- to 30-question multiple-choice final exam.

The OLAF education tool was not developed to replace current university students' in-person lectures and laboratory activities but rather to complement these activities. In this study, we focused the work presented here on the opinions of students enrolled in the field orientation course. However, the OLAF educational tool is open-platform, is accessible, free of charge, and is designed for anyone with an interest in field measurements of forest resources, which may include forestry and natural resource professionals seeking continuing education opportunities, high school students, 4-H and Future Farmers of America participants, and new landowners. The content of each course was developed to be approachable and not written in an overly technical manner. With approximately 10 million family-owned forests across the United States (Butler et al., 2021), OLAF is potentially an indispensable tool for learning how to measure and manage this land.

One concern with integrating an online component into the learning process is computer accessibility and Internet access (Appana, 2008; Barclay et al., 2018). For these assessments, this concern was mitigated, as students were required to have a laptop when they began taking classes in the Warnell School of Forestry and Natural Resources. Those who did not own a laptop could borrow one from the departmental information technology staff. Further, students also had access to computer labs within the school and other similar resources found at multiple locations across the university campus.

The results of three surveys provided to students registered for FANR 3000 during the fall 2021 semester are presented here. Although this period of time was within the COVID-19 time frame of concern, the university course was offered only through in-person instruction. Two student self-assessment surveys comprised pre- and post-exposure surveys of two separate courses in the OLAF educational tool: (a) land measurements and (b) tree and wood-related measurements. The objective of the pre- and post-exposure surveys was to determine whether the OLAF educational tool was successful in increasing the knowledge level and confidence of students with respect to concepts associated with field measurements in forestry and natural resources. Using the responses from both surveys, four null hypotheses were developed:

- H1: Students' understanding of concepts related to land measurements did not improve after completing the course in OLAF.
- H2: Students' confidence in applying concepts related to land measurements did not improve after completing the course in OLAF.
- H3: Students' understanding of concepts related to tree and wood-related measurements did not improve after completing the course in OLAF.
- H4: Students' confidence in applying concepts related to tree and wood-related measurements did not improve after completing the course in OLAF.

The final assessment survey was aimed at understanding student perspectives regarding the functionality of the OLAF educational tool. The content of the final assessment survey focused on student opinions of the usability, interactivity, and learning efficiency of the courses. The objective of the final assessment survey was to identify components of the OLAF educational tool that needed improvement or that worked well in their current form.

METHODS

During the fall 2021 semester (August–December), students (hereafter referred to as "survey participants") enrolled in the University of Georgia FANR 3000 course were asked to assess the effectiveness of the OLAF educational tool. Three surveys (pre-exposure to the topic, post-exposure to the topic, and final assessment) were designed with the goal of understanding whether principles, facts, and techniques

Table 1. 10 Courses Offered in the OLAF Education Tool

Course	Summary of course topics
Land Survey Systems	Surveying in the United States, Public Land Survey System, terms associated with county courthouse records
Land Measurements	Scale and ground distances, engineer's scale, distance with tapes or pacing, compass direction and declination, interior and deflection angles, error of closure, mapping from field measurements, area of closed traverse
Global Positioning Systems (GPS)	GPS positioning, types of receivers, sources of error
Geographic Information Systems (GIS)	Development of GIS, types of GIS databases, map projections, downloading GIS and manipulating data, map features
Tree and Wood-Related Measurements	Measuring tree diameter, height, and age; calculating basal area; estimating basal area of a stand; determining volume and weight of wood by using field measurements
Fixed Area Sampling With Plots	What to sample, calculating tree per acre or basal area, sampling intensity, systematic sampling, nominal sampling intensity
Fixed Area Sampling With Strips	Calculating down wood per acre and total down wood, sampling intensity, systematic sampling, nominal sampling intensity
Point Sampling	Prism sampling, basal area factor, calculating trees per acre and basal area per acre, unknown basal area factor determination
Basic Statistics	Data types and data description methods, graphic and numeric data representation, central tendency and dispersion, sample estimate reliability, hypothesis testing and statistical significance
Economics	Discount values, net present value, bare land value, benefit/cost ratio, internal rate of return, stumpage and delivered prices

were learned from exposure to two OLAF courses, the goal of understanding overall user satisfaction with the manner in which the OLAF educational tool was developed. These are important goals for measuring the effectiveness of training programs (Galloway, 2005). Each survey participant was assigned a username and emailed a link by the research professional (and website administrator) monitoring the assessment to create a password. Only the research professional had access to each survey participant's login name, allowing survey participants to access and matriculate through each course anonymously to the instructor, teaching assistants, and their fellow classmates. Survey participants were able to enroll in two courses within the OLAF education tool: (a) land measurements and (b) tree and wood-related measurements. The courses took approximately 1 and 2 hours, respectively, to complete. Each course covered several topics important for educating forestry and natural resources students at the university level (see Table 2). Survey participants' engagement with the online courses and the associated surveys was voluntary and not a component of their final university course grade.

Prior to beginning an OLAF course and prior to the curriculum introduced via lecture or laboratory instruction in FANR 3000, survey participants were given a pre-exposure survey, which comprised two categories of questions: (a) their understanding of a concept related to land measurements or tree and wood-related measurements and (b) their level of confidence in applying these concepts in practice. For example, survey participants were asked to rank their understanding of compass declination and then asked how confident they would be using declination while measuring the boundary of a parcel of land. Survey participants rated their level of understanding of a concept by using a 9-point Likert scale ranging from no understanding (1) to complete understanding (9). Similarly, when asked whether they would be able to implement a concept in the field, survey participants rated their level of confidence from not at all confident (1) to very confident (9). Additionally, survey participants were offered an opportunity to provide feedback on their experiences in using the OLAF educational tool through an open-ended solicitation at the end of each survey. This pre-survey was conducted in person and on paper. After 1 week of engaging with the OLAF educational tool outside the classroom and prior to the introduction of the topic in the classroom, following the completion of a single course, survey participants were given a post-exposure survey (the

Table 2. Topics Self-Assessed for Understanding and Confidence by Students Enrolled in FANR 3000 Before and After Using the OLAF Education Tool

Land measurements	Tree and wood-related measurements
Azimuth	Basal area
Bearing	Clinometer
Declination	Crown ratio
Error of closure	DBH
Interior angles	DBH tape
Precision of survey	d.i.b.
	Dominant species
	Increment borer
	Site index
	TPA

Note. DBH = diameter at breast height; d.i.b. = diameter of a tree inside the bark layer; TPA = trees per acre.

same survey as the pre-exposure survey) in person during the class period and asked again to rank their understanding of concepts and confidence in using concepts covered in the course.

A two-tailed paired *t* test was used to determine whether statistically significant differences existed between pre- and post-exposure survey questions related to survey participants' understanding of and confidence in topics offered in each OLAF course. If a survey participant only completed one of the two surveys—only completing the pre-exposure survey, for example—their responses were not included in the statistical analysis. Similarly, if a survey participant only provided a Likert score for a specific topic in one of the two surveys and not the other, that response was not included in the analysis. Additionally, if a survey participant commented that they did not finish the OLAF course, their responses were not included in the analysis.

The final assessment survey was created by using SurveyMonkey (surveymonkey.com) and was distributed to survey participants via an Internet link through the University of Georgia's eLearning Commons (eLC) learning management system. Each survey participant enrolled in the FANR 3000 class received an email from the research professional managing the questionnaire through the eLC system. Survey participants had access to the questionnaire for approximately 3 weeks after receiving the initial solicitation for participation on October 22, 2021. A reminder email was sent on November 5 and November 15, and the questionnaire was closed at the end of the day on November 15. The final assessment survey was divided into three sections: usability, interactivity, and learning efficacy. All three surveys (pre-exposure, post-exposure, and final assessment) were submitted to the University of Georgia Institutional Review Board; it was determined that human subjects research approval was not required.

RESULTS

SURVEYS OF COURSE MODULES

With respect to the pre-exposure survey related to the land measurement course in the OLAF educational tool, survey participants rated slightly higher their understanding of concepts related to important topics (azimuth, bearing, declination, and so forth; see Table 3) than they ranked their confidence in using these concepts in practice (see Table 4). Using a scale ranging from 1 to 9, with 1 indicating no understanding of a topic and 9 indicating complete understanding of a topic, an increase in understanding of topics ranging from 3.6 to 5.0 points occurred after reviewing the OLAF course. Notable increases in understanding were found regarding the concept of an azimuth, with most survey participants (88.4%) indicating that they had no understanding of an azimuth prior to using the OLAF educational tool, compared to 88.4% indicating a moderate to complete understanding of an azimuth in the post-exposure survey. Similarly, the majority of survey participants (88.1%) indicated no understanding of the concept of an error of closure in the pre-exposure survey, but a more moderate increase in understanding of the concept was noted in the post-exposure survey, with 73.8% of students ranking their understanding between moderate and complete understanding. Additionally, a more moderate increase in understanding was found when considering the topics of declination and precision of a survey. The result of the paired *t* tests ($p = 0.05$) between the pre-exposure and post-exposure surveys indicated that the H1 null hypothesis could be rejected, as there appeared to be a statistically significant increase in survey participants' understanding of concepts related to land measurements after interacting with the OLAF educational tool (see Table 4).

An overwhelming majority of survey participants who completed the pre-exposure survey indicated that they were not at all confident in applying any of the land-measurement concepts covered in the OLAF course. The post-exposure survey indicated that there was an increase in confidence in applying these concepts of 3.1 to 4.1 points across all topics (see Table 5). However, a greater level of spread was noticed in survey participants' responses in the post-exposure survey, as some survey participants indicated that they were still not very confident in their abilities at the time of the post-exposure survey. For example, 92.9% of survey participants indicated that they were not at all confident in their ability to use an azimuth as part of a land-measurements exercise in

Table 3. FANR 3000 Students' Average Rankings of Their Understanding of Topics in the Land-Measurement Course of OLAF (Likert Scale of 1–9, M = mean, SD = standard deviation)

	Pre-assessment			Post-assessment		
Topic	***n***	**M**	**SD**	***n***	**M**	**SD**
Azimuth	46	1.3	0.98	45	6.3	1.68
Bearing	46	2.0	1.27	45	6.2	1.76
Declination	46	1.5	0.86	44	5.9	1.88
Error of closure	46	1.3	1.04	44	5.3	1.97
Interior angles	46	2.1	1.42	45	5.7	1.92
Precision of survey	46	1.9	1.50	45	5.7	2.13

Table 4. Two-Tailed Paired *t* Test Results for Students' Understanding of Topics Included

Topic	*n*	*p*-value
Azimuth	43	0.0000
Bearing	43	0.0000
Declination	42	0.0000
Error of closure	42	0.0000
Interior angles	43	0.0000
Precision of survey	43	0.0000

the pre-exposure survey, with a standard deviation of 0.74. In the post-exposure survey, only one survey participant was still not at all confident, yet the standard deviation of responses more than doubled (2.04). Fewer students were not at all confident in using a bearing (76.2%), a declination (85.7%), interior angles (83.3%), and the precision of a survey (83.3%) during the pre-exposure survey than were not at all confident in using an azimuth. Improvements in confidence were evident in the post-exposure survey, as survey participants ranked their confidence from moderately confident to very confident in using a bearing (64.3%) and an azimuth (66.7%), reflected in an increased average ranking from 4 to 5 Likert scale points, respectively. Using a two-tailed paired *t* test, H2 null hypothesis was rejected, as there was a statistically significant ($p = 0.05$) increase in survey participants' confidence in using the land-measurement concepts described in the land-measurement OLAF course after interacting with the system (see Table 6).

With respect to the pre-exposure survey of the tree-measurement course in the OLAF educational tool, it is again clear that survey participants rated slightly higher their understanding of concepts of important topics (basal area, crown ratio, diameter at breast height [DBH], and so forth) than their confidence in applying these in practice (see Tables 7 and 8). An increase in average ranking in understanding ranged from 0.9 to 3.3 after the post-exposure survey was conducted. The smallest increase in understanding involved survey participants' understanding of how a clinometer is used to measure tree heights, with an increased ranking on average of approximately 1 Likert point. In the pre-exposure survey, 63.2% of survey participants indicated that they had a moderate to complete understanding of the concept. In the post-exposure survey, 71.1% of survey participants identified the same level of understanding of using a clinometer to measure tree heights. This is likely the result of having been exposed to the use of a clinometer in an earlier outdoor laboratory that focused on measuring ground slope. In the pre-exposure survey, there were several instances where the majority of survey participants indicated no understanding of a topic: crown ratio (60.5%), DBH (73.0%), DBH tape (71.1%), diameter of a tree inside the bark layer (d.i.b.; 80.0%), increment borer (66.7%), site index (61.1%), and trees per acre (TPA; 73.7%). For most of these, a majority of survey participants indicated an improvement in their understanding of these topics in the post-exposure survey. There were four instances where an improvement

Table 5. FANR 3000 Students' Average Rankings of Their Confidence in Implementing the Topics in the Land-Measurements Course of OLAF (Likert Scale of 1–9, M = mean, SD = standard deviation)

	Pre-assessment			Post-assessment		
Topic	***n***	**M**	**SD**	***n***	**M**	**SD**
Azimuth	45	1.2	0.74	45	5.3	2.04
Bearing	45	1.5	1.02	45	5.1	2.12
Declination	45	1.2	0.56	45	4.5	2.07
Error of closure	45	1.1	0.34	45	4.2	2.22
Interior angles	45	1.3	0.63	45	4.4	2.31
Precision of survey	45	1.2	0.52	45	4.5	2.24

Table 6. Two-Tailed Paired *t* Test Results for Students' Confidence Implementing Topics

Topic	*n*	*p*-value
Azimuth	42	0.0000
Bearing	42	0.0000
Declination	42	0.0000
Error of closure	42	0.0000
Interior angles	42	0.0000
Precision of survey	42	0.0000

occurred, yet there was greater variability in the degree of improvement: d.i.b., increment borer, site index, and TPA. For example, in the post-exposure survey, 45.7% of survey participants ranked their understanding of d.i.b. between no understanding and neutral understanding of the topic, while 54.3% ranked their understanding of d.i.b. from a moderate understanding to a complete understanding of the topic. Similar degrees of improvement were indicated in the post-exposure survey for the use of an increment borer (55.6%), site index (58.3%), and TPA (52.6%), indicating a moderate to complete understanding of these concepts. Using a two-tailed paired *t* test, we were able to reject null hypothesis H3, as there was a statistically significant ($p = 0.05$) increase in survey participants' understanding of the tree and wood-related measurement concepts described in the OLAF course (see Table 9).

According to the post-exposure survey of tree-measurement topics, an increase in confidence in using concepts of 0.8 to 3.2 points was observed, excluding the topic of the clinometer. Here, the level of spread was similar to the pre-exposure survey. A majority of survey participants indicated that they had no confidence in using the concepts covered in this course in the pre-exposure survey, including basal area (72.2%), crown ratio (77.8%), DBH (74.3%), DBH tape (75.0%), d.i.b. (82.9%), increment borer (80.0%), site index (75.0%), and TPA (80.6%). Following completion of the tree-measurement course, the post-exposure survey indicated that there were three topics where fewer than half of the survey participants indicated that they were moderately to very confident on a topic: increment borer (40.0%), site index (47.2%), and TPA (38.9%). Comparatively, even though confidence levels increased after interacting with this OLAF course, they were lower for some topics. As suggested above, 60% of survey participants suggested that they were not at all confident to neutral using an increment borer in practice, 52.8% in using site index, and 61.1% in using TPA. This suggests that hands-on experience would complement an online learning experience. However, using a paired *t* test, the null hypotheses related to survey participants' confidence in using concepts covered in the tree and wood-related measurements (H4) course could be rejected. Survey participants indicated a statistically significant ($p = 0.05$) improvement in their confidence in relation to each topic offered in the course (see Table 10).

Table 7. FANR 3000 Students' Average Rankings of Their Understanding of Topics in the Tree and Wood-Related Measurements Course of OLAF (Likert Scale of 1–9, M = mean, SD = standard deviation)

	Pre-assessment			Post-assessment		
Topic	***n***	**M**	**SD**	***n***	**M**	**SD**
Basal area	37	2.5	1.66	37	5.0	2.07
Clinometer	38	4.7	2.39	38	5.6	2.25
Crown ratio	38	2.1	1.78	38	4.9	2.03
DBH	37	2.0	1.91	37	5.3	2.25
DBH tape	38	1.9	1.80	38	5.2	2.16
d.i.b.	35	1.5	1.17	35	4.7	2.00
Dominant species	36	3.9	2.28	36	6.1	2.39
Increment borer	36	1.7	1.22	36	4.6	2.14
Site index	36	2.1	1.75	36	4.7	2.16
TPA	37	1.9	2.04	38	4.7	2.14

Note. DBH = diameter at breast height; d.i.b. = diameter of a tree inside the bark layer; TPA = trees per acre.

Table 8. FANR 3000 Students' Average Rankings of Their Confidence Using Topics in the Tree and Wood-Related Measurements Course of OLAF (Likert Scale of 1–9, M = mean, SD = standard deviation)

	Pre-assessment			Post-assessment		
Topic	***n***	**M**	**SD**	***n***	**M**	**SD**
Basal area	36	1.9	1.57	36	4.4	2.14
Clinometer	36	4.6	2.77	36	5.4	2.36
Crown ratio	36	1.5	1.00	36	4.3	2.13
DBH	35	1.8	1.65	35	4.9	2.24
DBH tape	36	1.8	1.63	36	4.8	2.17
d.i.b.	35	1.3	0.61	35	4.5	2.21
Dominant species	36	2.8	2.50	36	5.4	2.66
Increment borer	35	1.5	1.12	35	4.1	2.25
Site index	36	1.7	1.37	36	4.1	2.13
TPA	36	1.7	1.89	36	4.1	2.30

Note. DBH = diameter at breast height; d.i.b. = diameter of a tree inside the bark layer; TPA = trees per acre.

SURVEY OF THE OVERALL SYSTEM

In the final assessment of survey participants' overall experience using the OLAF educational tool, responses were ignored if they indicated that they did not use OLAF during the pre- and post-assessment periods. Of the 51 survey participants originally enrolled in the FANR 3000 course, 28 participated in the final assessment survey, resulting in a response rate of 55.0%.

USABILITY

When asked how OLAF was accessed, all survey participants indicated that a laptop computer was used; however, one survey participant also accessed OLAF by using a cell phone, and another survey participant accessed OLAF by using a desktop computer. Of these two latter respondents, there was no indication through the survey that the mode of access affected their experience. When asked whether they were able to complete the course in a reasonable amount of time, using

Table 9. Two-Tailed Paired *t* Test Results for Students' Understanding of Topics

Topic	*n*	*p*-value
Basal area	37	0.0000
Clinometer	38	0.0152
Crown ratio	38	0.0000
DBH	37	0.0000
DBH tape	38	0.0000
d.i.b.	35	0.0000
Dominant species	36	0.0000
Increment borer	36	0.0000
Site index	36	0.0000
TPA	38	0.0000

Note. DBH = diameter at breast height; d.i.b. = diameter of a tree inside the bark layer; TPA = trees per acre.

Table 10. Two-Tailed Paired *t* Test Results for Students' Confidence Implementing Topics

Topic	*n*	*p*-value
Basal area	36	0.0000
Clinometer	36	0.0403
Crown ratio	36	0.0000
DBH	35	0.0000
DBH tape	36	0.0000
d.i.b.	35	0.0000
Dominant species	36	0.0000
Increment borer	35	0.0000
Site index	36	0.0000
TPA	36	0.0000

Note. DBH = diameter at breast height; d.i.b. = diameter of a tree inside the bark layer; TPA = trees per acre.

a ranking from 1 to indicate that they completely disagreed and 9 to indicate that they completely agreed, survey participants were generally neutral (M = 5.4) in this regard. One survey participant indicated in an open-ended response that the courses took a long time to complete; however, they noted that they understood that the course covered a lot of information, and they would have been better able to complete the course if they had spaced out (better planned) the time they spent on the course instead of attempting to complete the entire course in 1 day.

Each course included a bar that allowed the user to track their progress, which survey participants strongly to completely agreed (M = 7.9) was useful. Additionally, survey participants agreed that they were able to leave the course and return without issue (M = 8.2). Survey participants nearly completely agreed that courses were organized logically (M = 8.1), found the process for changing passwords simple (M = 7.5), and found that Internet-based pages within the course loaded quickly (M = 7.4). The majority of survey participants indicated that they strongly to completely agreed that the course was easy to navigate, with an average ranking of 7.7 on the 1–9 scale. Similarly, survey participants strongly to completely agreed, with an average ranking of 7.9, that functions within the course (i.e., "next," "previous," and "complete" buttons) worked properly.

INTERACTIVITY

It has been noted that gamification can improve the experience of online education users (Aparicio et al., 2019; Raharjo et al., 2021). Survey participants were asked whether gamification would have improved the courses they accessed in the OLAF educational tool. Gamification was defined with examples including earning points, winning badges, and ranking on a leaderboard. Survey participants were generally neutral, with an average ranking of 5.2, that gamification would have improved their user experience. Similarly, survey participants were neutral (M = 5.4) toward the inclusion of additional video content. Currently, several of the topics in the OLAF educational tool include links to video content created by groups outside the research team and are used only as a supplement to content already covered in the course topics. Additionally, survey participants indicated that the graphics and images used within the courses they accessed were useful in explaining the topics, with an average ranking of 7.3, indicating that they strongly to completely agreed.

LEARNING EFFICACY

Prior to using OLAF, 100% of survey participants (n = 28) indicated that they had previously taken online learning courses, which may have included employee training, continuing education, and independent learning. Survey participants were asked to rank their level of comfort using online learning technology, with 1 being not at all comfortable and 9 being completely comfortable. Survey participants were overwhelmingly comfortable with using the OLAF educational tool, with an average ranking of 7.9.

As for preparing for successfully completing a course final exam, 85.7% of survey participants indicated that a list of equations would be of value, 67.9% of survey participants indicated that the ability to access OLAF courses during the exam would be beneficial, and 57.1% of survey participants indicated that a downloadable PDF version of the course content would be useful. Only 7.1% of survey participants indicated that a recap (review) of the important parts of each section of an OLAF course would be of value to them in preparing for a course final exam. Interestingly, survey participants indicated that in general (unrelated to OLAF), they did not learn subject matter better in an online environment compared to in-person instruction. When ranked from 1 (completely disagree) to 9 (completely agree), survey participants' average ranking was 3.9. However, survey participants strongly agreed (M = 6.9) that topics they interacted with in the OLAF educational tool helped them understand concepts that they subsequently were exposed to during in-person instruction. On a promising note, survey participants indicated that they would likely complete additional courses in the OLAF educational tool, with an average Likert scale ranking of 6.4 on a scale of 1 (very unlikely) to 9 (very likely). Using the same Likert scale, survey participants generally agreed (M = 5.9) that they were more successful in learning new subject matter from online content as compared to books. On average, survey participants strongly agreed that the practice quizzes were helpful in reinforcing information covered in the OLAF courses (M = 7.3) and that the final exams in the OLAF courses adequately addressed information included in each OLAF course (M = 7.4).

DISCUSSION

Being exposed to, and ideally learning about, new concepts through online means can be time-consuming for some students (Appana, 2008) due to requirements for interacting with an online system and the volume of reading that may be required to complete a course. Several survey participants, through the pre- and post-exposure surveys and the final assessment survey, pointed to this issue. However, although several survey participants noted that they did not have time to finish either or both of the OLAF courses, it is uncertain whether the survey participants had planned accordingly to do so. Motivation is an important component of a person's success in using online learning tools (Otter et al., 2013). As described by Lynch and Dembo (2004), motivation comprises two components: (a) self-efficacy, or the person's own understanding of their capacity for achieving goals and the methods required for doing so, and (b) the goals of each person. Motivation is also affected by three innate psychological needs of people—autonomy, relatedness, and competence—and when these are satisfied, motivation levels are higher than when they are not satisfied (Ryan & Deci, 2000). For the people who engaged with the OLAF educational tool, their participation was not related to the grade they might have received in the university course (FANR 3000) in which they were enrolled, nor was it the only source of course curriculum as an in-person lecture occurred. Instead, OLAF was presented as an online tool that might aid in their understanding of concepts that would eventually be covered in the university course. Therefore, beyond exposure to new content and ideas and the gain in confidence one might receive from interacting with the OLAF educational tool, there was no additional incentive for a student to participate. This may have influenced their motivation and their overall impression of the individual OLAF courses, as they would have to rely on their cognitive motivation, or their desire to increase their knowledge or development (Berestova et al., 2022), to encourage their use of OLAF.

One important factor in the usability, and therefore successful adoption, of an online learning tool is the functionality of the online system itself (Pituch & Lee, 2006). In general, the OLAF educational tool met the expectations of the survey participants, and on the basis of the system functionality, the system seemed to be successfully developed. The delivery of applied forestry concepts through an online environment will allow OLAF to potentially grow and be readily modified. Certainly, regular assessments of participant perception of the learning environment will be important in continuously improving the OLAF educational tool. For example, further development of the OLAF educational tool might include discussion forums to increase engagement. Ogange et al. (2018) found that this avenue of discussion for providing feedback in an online environment can be beneficial for online learners. An ideal discussion forum would need to rely on a moderator to filter appropriate and inappropriate content that is offered and to provide feedback promptly to benefit participants (Ogange et al., 2018), as feedback is an important factor in determining user satisfaction (Gaytan & McEwen, 2007; Lawton et al., 2012). However, the feedback loop is a two-way street, and not all feedback is equally beneficial. Specifically, feedback from an online educational system, such as successful completion of online quizzes and exams or hints directing people to correct question answers, have been shown to be beneficial to user satisfaction, yet feedback provided in the form of grades could also act to discourage the user satisfaction of online course participants (Lawton et al., 2012). Finally, although survey participants indicated that a downloadable PDF version of the course content would be useful, a discussion of the potential of survey participants to game the system rather than attempt to learn the material would seem to be necessary (Baker et al., 2008). In addressing these issues, the options involved in improving or maintaining user satisfaction with an online learning environment would need to be considered if the system were to be sustained over time.

Finally, it has been noted that the addition of gamification can play a role in further engaging participants of online courses and may be a factor in determining the success of online learning systems. Perhaps gamification could help improve participant completion rates and overall course grades and serve as a motivating factor for engaging in an online course (Sailer et al., 2017). Gamification can include avatars, leaderboards, in-group competitions, and general feedback, including badges and points (Aparicio et al., 2019). Since completion of the surveys in the fall of 2021, a few areas of gamification have been added to the OLAF educational tool. For example, upon completing an individual OLAF course and upon successfully passing the final exam associated with a course, participants now receive a badge and are presented with a pop-up banner promoting their accomplishment. Further, as this is an open system available to learners outside the university context, the courses have been certified for continuing forestry education credits through the Society of American Foresters. When participants complete a course and pass a final exam, they are awarded a certificate. Although survey participants were only moderately interested in gamification, an additional assessment may now be necessary to evaluate the addition of these components to the OLAF educational tool.

Online platforms that act as learning environments are increasingly more popular with learners due to their flexibility, and some students indicate that better learning outcomes are achieved in this environment (Appana, 2008). Extension professionals should remain open to interacting with and taking advantage of the low barrier to entry provided through online learning platforms (Woods & Langcuster, 2014) like the one described here. Although interactivity among students within the OLAF system is limited, the system was designed to possibly allow for this sort of interactivity to be developed in the future. These types of online systems are relatively simple to build through Web-based learning management systems, providing Extension professionals with opportunities to create their own courses that could be easily accessed by and distributed across the vast geography of different learning communities. As we have illustrated here, pre- and post-assessments of these platforms, along with assessments of their overall effectiveness, are an important component of improving and maintaining online learning environments and should be considered a crucial part of implementing and integrating these systems into Extension instruction.

CONCLUSION

The results of the pre- and post-exposure surveys for the two OLAF courses survey participants accessed related to land measurements and tree and wood-related measurements indicate statistically significant improvements in their understanding of and confidence in using these concepts. In fact, statistically significant increases in knowledge of and confidence in every subtopic in each OLAF course were observed. Further, it was found that survey participants were generally satisfied with the usability, interactivity, and learning efficacy of using the OLAF educational tool. Survey participants suggested that having access to course materials during the final exams would be beneficial. Interestingly, survey participants were generally interested in certain aspects of gamification being further incorporated into the system, although these were not deemed important for the overall success of the system.

REFERENCES

Aparicio, M., Oliveira, T., Bacao, F., & Painho, M. (2019). Gamification: A key determinant of massive open online course (MOOC) success. *Information and Management*, *56*, 39–54. https://doi.org/10.1016/j.im.2018.06.003

Appana, S. (2008). A review of benefits and limitations of online learning in the context of the student, the instructor, and the tenured faculty. *International Journal on E-Learning*, *7*(1), 5–22.

Baker, R., Walonoski, J., Heffernan, N., Roll, I., Corbett, A., & Koedinger, K. (2008). Why students engage in "gaming the system" behavior in interactive learning environments. *Journal of Interactive Learning Research*, *19*(2), 185–224.

Barclay, C., Donalds, C., & Osei-Bryson, K-M. (2018). Investigating critical success factors in online learning environments in higher education systems in the Caribbean. *Information Technology for Development*, *24*(3), 582–611. https://doi.org/10.1080/02681102.2018.1476831

Berestova, A., Burdina, G., Lobuteeva, L., & Lobuteva, A. (2022). Academic motivation of university students and the factors that influence it in an e-learning environment. *Electronic Journal of E-Learning*, *20*(2), 201–210. https://doi.org/10.34190/ejel.20.2.2272

Bettinger, P., Izlar, B., Harris, T., Cieszewski, C., Conrad, J., Greene, D., Mech, A., Shelton, J., Siry, J., Kane, M., Merry, K., Baldwin, S., & Smith, J. (2019). *Handbook of land and tree measurements.* Harley Langdale Jr. Center for Forest Business, University of Georgia.

Butler, B. J., Butler, S. M., Caputo, J., Dias, J., Robillard, A., & Sass, E. M. (2021). *Family forest ownerships of the United States, 2018: Results from the USDA Forest Service, National Woodland Owner Survey* (General Technical Report NRS-199). U.S. Department of Agriculture, Forest Service. https://www.fs.usda.gov/research/treesearch/62180

Cantrell, S. W., O'Leary, P., & Ward, K. S. (2008). Strategies for success in online learning. *Nursing Clinics of North America*, *43*(4), 547–555. https://doi.org/10.1016/j.cnur.2008.06.003

Chick, R. C., Clifton, G. T., Peace, K. M., Propper, B. W., Hale, D. F., Alseidi, A. A., & Vreeland, T. J. (2020). Using technology to maintain the education of residents during the COVID-19 pandemic. *Journal* *of Surgical Education*, *77*(4), 729–732. https://doi.org/10.1016/j.jsurg.2020.03.018

Daultani, Y., Goswami, M., Kumar, A., & Pratap, S. (2021). Perceived outcomes of e-learning: Identifying key attributes affecting user satisfaction in higher education institutes. *Measuring Business Excellence*, *25*(2), 216–229. https://doi.org/10.1108/MBE-07-2020-0110

Galloway, D. L. (2005). Evaluating distance delivery and e-learning is Kirkpatrick's model relevant? *Performance Improvement*, *44*(4), 21–27. https://doi.org/10.1002/pfi.4140440407

Gaytan, J., & McEwen, B. C. (2007). Effective online instructional and assessment strategies. *American Journal of Distance Education*, *21*(3), 117–132. https://doi.org/10.1080/08923640701341653

Hussein, L. A., & Hilmi, M. F. (2021). The influence of convenience on the usage of learning management system. *Electronic Journal of E-Learning*, *19*(6), 505–515. https://doi.org/10.34190/ejel.19.6.2493

Lawton, D., Vye, N., Bransford, J., Sanders, E., Richey, M., French, D., & Stephens, R. (2012). Online learning based on essential concepts and formative assessment. *Journal of Engineering Education*, *101*(2), 244–287. https://doi.org/10.1002/j.2168-9830.2012.tb00050.x

LearnDash. (2022). https://www.learndash.com/

Lynch, R., & Dembo, M. (2004). The relationship between self-regulation and online learning in a blended learning context. *International Review of Research in Open and Distributed Learning*, *5*(2). https://doi.org/10.19173/irrodl.v5i2.189

Ni, A. Y. (2013). Comparing the effectiveness of classroom and online learning: Teaching research methods. *Journal of Public Affairs Education*, *19*(2), 199–215. https://www.tandfonline.com/doi/abs/10.1080/15236803.2013.12001730

Ogange, B. O., Agak, J. O., Okelo, K. O., & Kiprotich, P. (2018). Student perceptions of the effectiveness of formative assessment in an online environment. *Open Praxis*, *10*(1), 29–39. http://doi.org/10.5944/openpraxis.10.1.705

Otter, R. R., Seipel, S., Graeff, T., Alexander, B., Boraiko, C., Gray, J., Petersen, K., & Sadler, K. (2013). Comparing student and faculty perceptions of online and traditional courses. *Internet and Higher Education*, *19*, 27–35. https://doi.org/10.1016/j.iheduc.2013.08.001

Pituch, K. A., & Lee, Y.-K. (2006). The influence of system characteristics on e-learning use. *Computers and Education*, *47*, 222–244. https://doi.org/10.1016/j.compedu.2004.10.007

Raharjo, S. R., Handayani, P. W., & Putra, P. O. H. (2021). Active student learning through gamification in a learning management system. *Electronic Journal of E-Learning*, *19*(6), 601–613. https://doi.org/10.34190/ejel.19.6.2089

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68. https://doi.org/10.1037//0003-066x.55.1.68

Sailer, M., Hence, J. U., Mayr, S. K., & Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Computers in Human Behavior*, *69*, 371–380. https://doi.org/10.1016/j.chb.2016.12.033

Woods, K., & Langcuster, J. C. (2014). The use of digital technology in Extension. *Journal of Extension*, *52*(5), Article 32. https://tigerprints.clemson.edu/joe/vol52/iss5/32/

Yi, M. Y., & Hwang, Y. (2003). Predicting the use of Web-based information systems: Self-efficacy, enjoyment, learning goal orientation, and the technology acceptance model. *International Journal of Human-Computer Studies*, *59*, 431–449. https://doi.org/10.1016/S1071-5819(03)00114-9

Zhang, D., Zhao, J. L., Zhou, L., & Nunamaker, J. F. (2004). Can e-learning replace classroom learning? *Communications of the ACM*, *47*(5), 75–79. https://doi.org/10.1145/986213.986216