

**Evaluation of Online Courses and GRIN-U.org Learning Materials
USDA-NIFA Higher Education Challenge Grant Project:
Enhancing Educational Outcomes for Plant Genetic Resources Conservation and Use**

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1. Project Overview

Crop production, protection, and thus global food security depend on plant genetic diversity. The U.S. National Plant Germplasm System (NPGS) is among the world's largest collections of plant genetic resources (PGR). Researchers use PGR to evaluate and develop cultivars with improved resistance to biotic and abiotic threats, product qualities, and enhanced yields (Byrne et al., 2018). Qualified, trained personnel are critical to maintaining the NPGS collections (Volk et al., 2019b), a personnel and training challenge well-suited to Human Resource Development (HRD) expertise.

The NPGS and other global genebanks need technologies and management techniques to ensure materials are healthy, true-to-type, well-documented, and available for future generations. Although some PGR educational materials exist, there are coverage and availability gaps (Friesner et al., 2021). In an online survey, most respondents either “strongly agreed” or “agreed” with 1) there is a shortage of high-quality PGR learning materials, 2) availability of high-quality PGR learning materials would provide useful information in my current position, and 3) the availability of high-quality PGR learning materials would be useful in teaching or providing information to others (Volk et al. 2019a).

In response to Volk et al.'s (2019a) results, this USDA-NIFA-funded project aimed to improve PGR training resources available to the agricultural workforce. An online repository was created to provide open access to PGR educational and training content, disseminate materials broadly, and use web analytics to track usage. Additionally, the materials were utilized to develop three 1-credit-hour graduate-level online courses.

This report presents students', web subscribers, and PGR professionals' perceptions of the learning content, including any changes in career interests. We detail the project's activities and outcomes in support of these aims. A core team conducted all activities, and was comprised of members from Colorado State University (CSU), Iowa State University (ISU), and the United States Department of Agriculture (USDA).

2. Summary of Materials and Data Sources

Graduate Courses

This project developed three graduate-level 1-credit online courses (SOCR 501, 502, 503), which can be taken individually or completed as a series. All learning materials are compatible with either an online, stand-alone approach or embedded in a “flipped” course, a learner-centered model in which content presentation occurs outside class.

	Course	2021	2022	2023	Total
I.	SOCR 501, Origins	13	20	15	48
II.	SOCR 502, Conservation	-	17	19	36
III.	SOCR 503, Discovery	-	17	13	30
	Total	13	54	47	114

All students who participated in any of the three courses were invited to complete the survey. Survey invitations were distributed to students in the semester immediately following the course, e.g., Fall 2022 students were recruited in the spring of 2023. Invitations were sent by Dr. Morris, the primary instructor of the courses.

Web Users

Web access to the GRIN-U online materials is available through the publicly available repository located at <https://grin-u.org/>. Visitors to the repository are invited to subscribe to the GRIN-U email list, which provides information on new available materials and updates to the website. All 86 subscribers to the email list were invited to participate in the survey.

Data Collection

This project applied a survey-based approach distributed via Qualtrics. All activities, including participant consent, were conducted according to protocols approved by CSU’s institutional review board. The course survey had a 43% response rate, and the web user survey had a 17% response rate. Across both surveys, 33 participants started the survey. Of those, 13 students completed the course survey, and 15 people completed the webuser survey. Specific to the course participants, eight of the students (61%) took at least one course as part of a degree program, while the other five (38%) were non-credit participants. Eight students completed all three courses (61%), two students completed course one (15%), two students completed course two (15%), and one student completed courses two and three (8%).

3. Participant Overview

This section presents a summary of participant personal and demographic qualities. Table 1 and Table 2 illustrate the variety of participants' professional contexts and job titles.

Table 1. Participants' Professional Contexts

Professional Context	Course Survey*	Web User Survey**
Gov Agency/Institution	6	9
Academia-Faculty/Staff	3	4
For-profit Industry	1	1
Non-profit	2	0
Other	0	1
No response	1	0

*n= 13, **n=15

Table 2. Participants' Job Titles

Course Survey*	Web User Survey**
Biodiversity Officer	Professor (3)
Biological Science Technician Plants	Associate Extension Specialist and Professor
Consultant	Botanist
Environmental Science Chair	Curator
Executive Director	Founder
Farm Owner/Operator, Environmental	Instituto Nacional de Investigaciones
Science Chair	Agropecuarias (Ecuador)
Germplasm Conservation Supervisor	Land Manager
Graduate Student (2)	Online Instructor
Legume Conservation	Researcher
Research Assistant	Research Technician
Senior Research Scientist	Scientist
USDA Pathways Curator Intern	Technician
	USDA PhD Pathways Program

*n= 13, **n=15

Figure 1 depicts participants' educational backgrounds. Note that most participants across both surveys already possessed graduate degrees.

Figure 1. Participants' Highest Degree or Level of School Completed

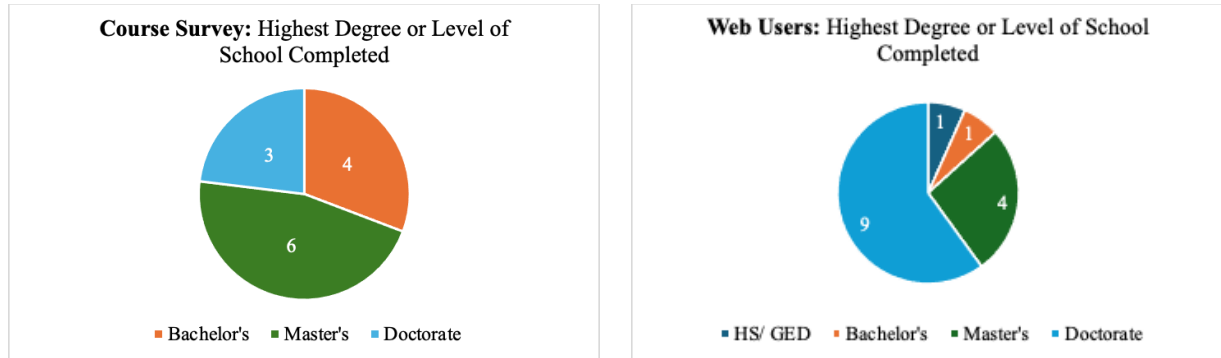


Table 3 shows that most students taking the course (96%) rated their general and career interest in Plant Genetic Resources (PGR) as interested or very interested. Eight of these students (61%) also indicated that they are currently employed (full or part-time) in the Agricultural or Food industries. Table 4 displays demographic data from the course participants.

Table 3. Course Participants' General and Career Interest in Plant Genetic Resources

	General Interest in PGR*	Career Interest in PGR*
Very Interested	9	9
Interested	4	3
Neutral	0	1

*n=13

Table 4. Course Participants' Demographic Data

Course Survey Participants*	Man	Woman
25-24 years	<p>5</p> <ul style="list-style-type: none"> Asian/Pacific Islander/Native Hawaiian Black or African American Hispanic or Latinx White/Caucasian Other: Filipino 	<p>2</p> <ul style="list-style-type: none"> White/Caucasian Prefer Not to Specify
35-44 years	<p>2</p> <ul style="list-style-type: none"> Asian / Pacific Islander/ Native Hawaiian White/Caucasian White/Caucasian 	<p>3</p> <ul style="list-style-type: none"> Black or African American White/Caucasian Other: Louisiana Creole Cajun, Ashkenazi Jew
45-54 years	0	0

55-64 years

0

1

• White/Caucasian

*n=13

4. Survey Results

This section presents a summary of participant responses pertaining to their perceptions of and experiences in the course and on the GRIN-U website. Table 5 lists how participants learned about activities and materials. One participant specifically named Luigi Guarino's weblog as how they learned about the course.

Table 5. Finding the Course or GRIN-U

Course Participants*	Web Users**
How did you learn about or find this course?	How did you hear about GRIN-U?
Prof Colleague 10	Colleague or Friend 7
Academic Institution 2	Conf/Prof Event 3
No Response 1	Email List/Newsletter 1
	Gen News Article 1
	Academic Institution 1
	Other 2
*n=13	**n=15

Figure 2 indicates that survey respondents had many motivations for taking the courses and visiting the GRIN-U website. Overall, and across both respondent groups, participants sought specific knowledge and skills.

Figure 2. Motivation for Visiting the GRIN-U Website

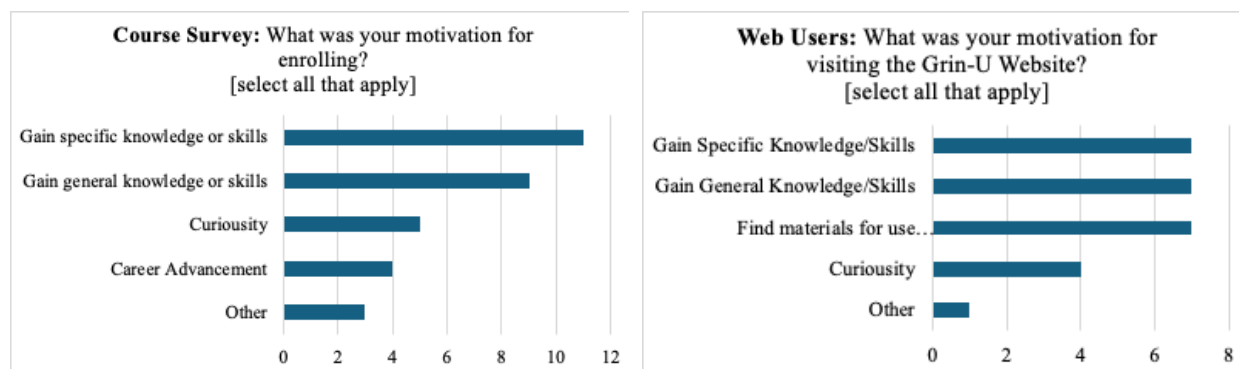


Table 6 indicates most participants (93%) viewed their overall learning experience or perception of the GRIN-U resources as good or very good. The web user who rated the GRIN-U resources as poor also indicated that a High School degree was their highest level of schooling. Their perception of the content may be influenced by their background knowledge or perception of the material as accessible, or not.

Table 6. Rating of Learning Experience or Resources

	Course Participants* How would you rate your overall learning experience?	Web Users** How would you rate your overall perception of GRIN-U resources?
Very Good	7	9
Good	5	5
Neutral	1	0
Poor	0	1
	*n=13	**n=15

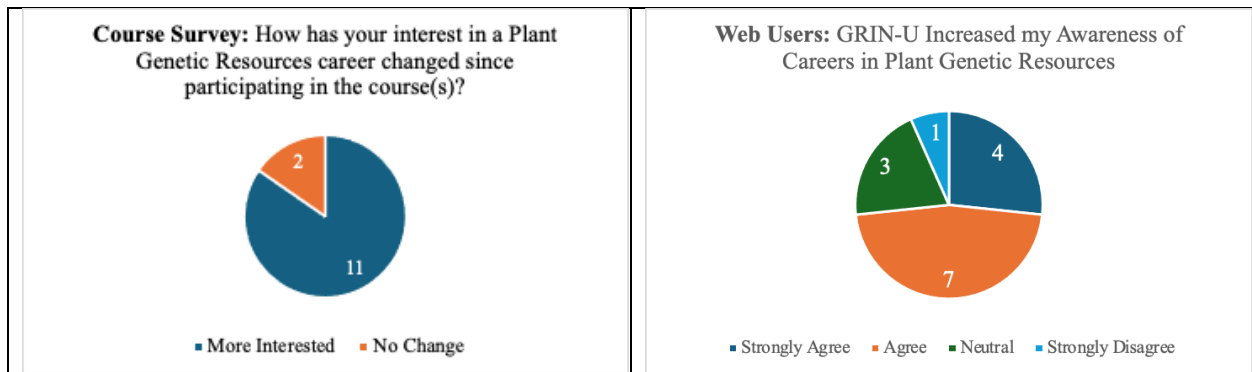
The Web Users were asked if they used GRIN-U materials in a class or training event. Three participants (20%) indicated they were instructors using the materials with their students. Table 7 highlights the number and level of their learners and the focus of the respective classes Table 7. Populations that GRIN-U Resources were used to Supplement Instructor’s Courses.

Table 7. Populations that GRIN-U Resources were used to Supplement Instructor’s Courses

Number of Students	Level of Students	Focus of the Class
30	College or university graduate students	Plant breeding and plant germplasm conservation
2-3	Industry or workforce professional development	Bag-head amaranth pollination
300 in person within the last 30 days	Public education/social media/seminar presentations	Metabolic health and Sustainability

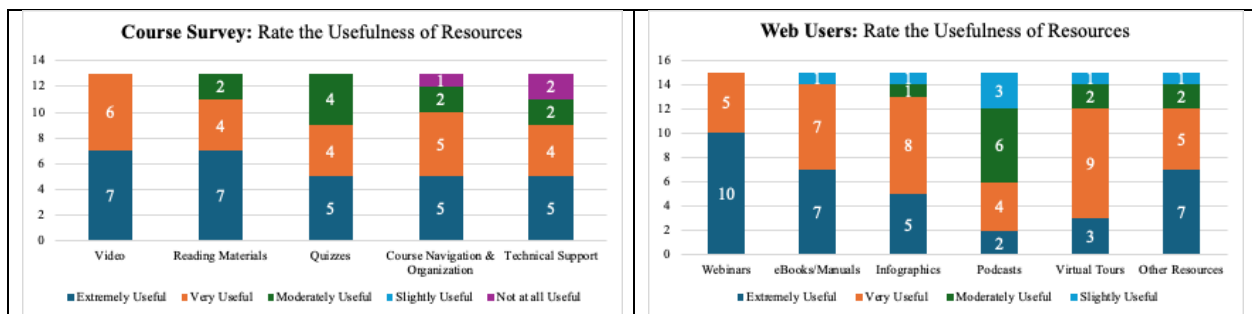
Figure 3 shows the responses regarding careers in Plant Genetic Resources. For the course participants, 85% indicated they were more interested in a Plant Genetic Resources career due to participating in the CSU Online course(s). Similarly, 73% (Strongly Agree and Agree) of the web users indicated that GRIN-U increased their awareness of careers in Plant Genetic Resources.

Figure 3. Changes in PGR Career Interest as a Result of GRIN-U



When asked to rate the usefulness of the course resources, participants indicated the videos and reading materials were the most useful, while course navigation/organization and technical support received the lowest ratings, as shown in Figure 4. The web users responded that the webinars and eBooks/Manuals were the most useful resources, while the virtual tours and podcasts were identified as least useful, also shown in Figure 4.

Figure 4. GRIN-U Resource Usefulness



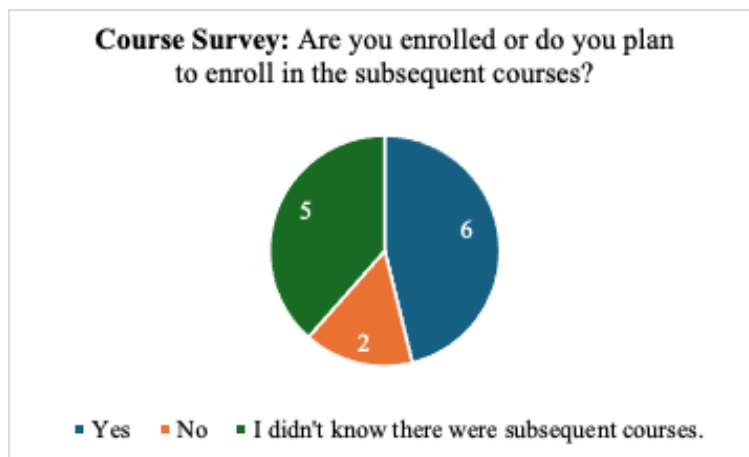
The web users were asked to rank the top three GRIN-U training topics of greatest interest to them. As shown in Table 8, Genebank Fundamentals and Collection Maintenance were identified as the most interesting topics, while Crops and Cultures, Virtual Tours, and Documents/GRIN Global were classified as the least interesting training topic. For example, Genebank Fundamentals was identified as the most interesting topic by 4 students and the second most interesting topic by 4 students. Collection Maintenance was the most interesting topic for two students and the second most interesting topic for six students.

Table 8. GRIN-U Training Topics of Interest

Web User Rating	Genebank Fundamentals	Collection Maintenance	Phenotyping and Genotyping	Crop Wild Relatives	Plant Breeding	Crops and Cultures	Virtual Tours	Documentation and GRIN Global
1	<u>4</u>	2	1	3	2	1	0	2
2	4	<u>6</u>	1	0	1	3	0	0
3	2	2	<u>4</u>	1	1	1	2	2
4	3	1	3	<u>4</u>	0	1	3	0
5	1	3	4	3	<u>4</u>	0	0	0
6	1	0	1	3	3	<u>7</u>	0	0
7	0	1	0	1	3	2	<u>7</u>	1
8	0	0	1	0	1	0	3	<u>10</u>

Shown in Figure 5, course participants were asked if they would enroll in subsequent courses. The majority (46%) indicated that they would take a successive course. A significant portion of the students (38%) were unaware of subsequent courses. Only 2 participants (15%) said they would not take further courses.

Figure 5. Plans to Take Subsequent Courses



5. Qualitative Feedback

Course participants were asked to rate their overall learning experience and had the opportunity to provide qualitative feedback about their rationale and how their learning experience could be improved. Table 9 aligns participants' quotes with their ratings.

Table 9. Course Participant Qualitative Feedback

Rating	Rationale	How could we improve your learning experience?
Very Good (7)	<ul style="list-style-type: none"> • I got a lot of new information • My current research interest is understanding the underlying mechanisms contributing to trait variation. The course provided an important foundation for how crop diversity is maintained, characterised and utilised for crop improvement. • It was laid out well and very engaging. All the PGR material was new to me. • Courses are entertainingly supplemented with videos courses and documentaries • I felt the courses covered a wide range of topics I was interested in and allowed me to get a base understanding so I could do further research. • Good balance of review, new, and upcoming topics. Topics ties back into stakeholders. Only classes available to learn about treaties, agreements, and SMTA's 	<ul style="list-style-type: none"> • More success stories of what research, science and genetics helped save crop industries and other large contributing impacts. • I felt at times that the pressure to get so much of the work done within the week made me focus more on getting things done rather than really taking in the material. • Break Learning Into Chunks • I took this course for credit and the material was a lot to juggle on top of an already full teaching load. I would love to explore some of these courses in the summer months when there is less commitment on my end. • I found my learning experience adequate. • Reading and listening • Not all but some of the assignments were a bit repetitive. I might have liked building off of last weeks work and picking a crop and spending more time than one week of reading and research. I am not sure if the other PGR agencies technicians focus on a group of plants or are responsible for many. The discussions were not as useful as I would have expected. I think because they essentially closed on the Sunday and the next module started Monday it was difficult to work on the new material and go back and read all of the comments that came in over the weekend.
Good (5)	<ul style="list-style-type: none"> • I would like to learn about seed [duration]. • It had a clear outline and guide for learning from the basics to applied projects. • There was a lot of emphasis put on seed resources, but not clonal resources • Course I and III were fantastic opportunities to search for reading material on the plants I was responsible to grow. Great opportunity to learn on the job. 	

Rating	Rationale	How could we improve your learning experience?
Neutral (1)	<ul style="list-style-type: none"> [The professor] was great-- supportive, and the material was well thought out. Also, it was so far beyond me to be able to read and write responses at that graduate level. If inclusivity is a priority, I would say organize at least 1 meet-up where the course participants can collectively contribute responses to readings and teachings and a recording is available for anyone unable to attend. That way, there are potential impacts for everyone at whatever level they are trying to access the information. Accessibility to research and education like this isn't really available at this level in my region, and I am very committed to finding accessible education to skill-build and share with other producers. Feedback for University and Admin and Non-support for non-credit Students — I had technical difficulties before the course even began and it took 3 days into the course for me to get access. And, I was repeatedly sent from department to department as no one seemed to know who was supposed to provide support to online non-credit students. I eventually had to give up on my course material because I couldn't keep up with the pace of the course and my everyday responsibilities of managing my farm and being a parent. At some point, the inefficiencies of an online system and admin like that eats up my time and makes the class far more expensive than \$400 to take because my time as a producer, parent, and 	<ul style="list-style-type: none"> We would like to have more information on clonal management. The video display was inconsistent. Sometimes the window with the speaker was very large and could not be repositioned interfering with the content. We did not take the quizzes. Providing more details into specific projects and probably a hands-on experience would have made some of these concepts be more clear. Create open access material with public funds and develop partnerships with regional producers. There is much research that can be done in the Gulf South - we have the remainder of some subsistence agricultural communities in the US and we will certainly have more in the advent of climate change. I see it as the responsibility of public universities and academic professionals to direct their research to support ongoing food sovereignty work when those producers are seeking knowledge.

Rating	Rationale	How could we improve your learning experience?
	community member is valuable. I feel that CSU messed up due to its inability to provide adequate support for a paying student.	

6. Recommendations for Future Work

PGR:

- Inform future instructional design decisions
- Aid in the enhancement and maintenance of the project's academic modules
- Provide the PGR community with means to recruit and support the future workforce

INDUSTRY:

- Insight into training and development, workforce development, and career development
- Opportunities for professional training of skilled STEM workers, and capacity-building in high-needs and critical infrastructure industries