

Undergraduate Research Course Assessment Practices in a College of Agricultural and Life Sciences



Wendy J. Dahl¹, Amanda L. Ford¹, and Allen F. Wysocki²

¹Food Science and Human Nutrition Department, University of Florida

²Food and Resource Economics Department, University of Florida

Author Note

AUTHOR 1 <https://orcid.org/0000-0000-0000-0000>

AUTHOR 2 <https://orcid.org/0000-0000-0000-0001>

Correspondence regarding this article should be addressed to Wendy J. Dahl, Food Science and Human Nutrition Department, University of Florida, Gainesville, FL, 32611. Email: wdahl@ufl.edu. Phone: 352-294-3707.

Abstract

Undergraduate research experiences provide engaging learning opportunities but are often not formally assessed for gains in knowledge and skills. This study examined undergraduate research assessment practices and the implementation of a satisfactory/unsatisfactory (S/U) research course in all academic units within a college of agricultural and life sciences. During the 2013-2014 academic year, undergraduate students registered for a letter-graded research course, and faculty supervising undergraduate research experiences were surveyed regarding assessment practices. Based on survey responses, an S/U 0-3 credit research course and syllabus template were implemented. Undergraduate students were subsequently surveyed on their 2015 and 2020 fall semester research course experiences. At baseline, most students did not receive a course syllabus (87%), however, they were verbally informed of research expectations (89%). Grades were determined by attendance and participation, and these findings were confirmed by the faculty respondents. Following implementation, 58% agreed or strongly agreed that they were more likely to participate in research with a 0-credit option and that having research on their transcript was important (89%). By 2020, 64% of respondents preferred a 0-credit option. Receiving a syllabus continued to be uncommon. S/U-grading of undergraduate research may be most appropriate for participatory-based assessment; however, steps are needed to promote the 0-credit option and ensure syllabi use for transparency of course expectations and assessment criteria.

Keywords: undergraduate research, assessment, syllabi, grade transcript

Undergraduate research experiences allow students to learn new knowledge and skills in an immersive, multifaceted environment. These research experiences have been shown to improve self-reported research skills, promote STEM career choice (Adedokun et al., 2012; Carpi et al., 2017; Odera et al., 2015), retain students in scientific fields (Beck et al., 2007; Chang et al., 2014; Vieyra et al., 2011), enrich of cognitive and personal skills with multi-year experiences (Thiry et al., 2012), and increase students' satisfaction with their undergraduate program (Sears et al., 2017). However, as Haeger et al. (2020) note, reports of undergraduate research impacts are primarily associative. Research is needed to confirm causal relationships between undergraduate research experiences, skill development, and career choice (Haeger et al., 2020). Additionally, the evaluation of undergraduate research outcomes must consider unintended consequences, as some students report negative experiences (Yaffe et al., 2014).

The models for delivery of undergraduate research experiences, such as summer programs (Moss, 2011; Wilson et al., 2018), course-based undergraduate research experience (CURE) (Auchincloss et al., 2014), and various mentoring approaches (Nicholson et al., 2017) share common goals – developing research skills and promoting interest in STEM fields. CURE course outcome assessments have utilized the Classroom Undergraduate Research Experiences Survey, which queries if “the learning experience resembles the practice of science research,” “student report of learning gains,” and “student attitudes toward science” (Auchincloss et al., 2014). However, for course-based research experiences, student learning assessment is needed for grade determination, whereas summer research

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internship programs that are not designed for course credit do not require this additional step. It is unclear if student learning outcomes are formally assessed in less structured mentee-mentor models of undergraduate research, although letter grades may still be assigned. Additionally, it is not known whether course syllabi are commonly used to outline objectives and assessment methods in less-structured undergraduate research course models. Given that course grades are a common source of student grievance (Gynnild, 2011), using standardized assessment methods detailed in a well-designed course syllabus provides the framework for the educator and direction for students is considered best practice (Hess & Whittington, 2003). Furthermore, mentee-mentor-modeled research courses when letter-graded may affect grade point averages even though they are not formally assessed for student learning. Using a case study approach, the aims of this study were 1) to determine undergraduate research assessment of student learning practices, 2) to assess the prevalence of syllabi use in undergraduate research courses, and 3) to evaluate the implementation of a satisfactory/unsatisfactory (S/U), 0-credit research course in a college of agricultural and life sciences.

Methods

Prior to this study, it was common practice for some students in the College of Agricultural and Life Sciences (CALs) at the University of Florida to volunteer as research assistants instead of registering for a graded research course. Student volunteers required notarized vetting, which consumed department staff effort. In this environment, tracking student research efforts and involvement was incomplete, as only those students registered for research course credit were typically identified. Volunteer research experiences were not documented in student transcripts, and thus, students' demonstration of proficient research skills was not officially documented, and conversely, students exhibiting poor performance lacked accountability. Another concern was the possibility that assigning 'A' grades for

participatory research efforts with little or no assessment of student learning contributed to grade inflation. In response to these issues, surveys were developed to explore how undergraduate students registered for independent research credit were assessed, specifically to determine how grades were assigned and if course syllabi were being used to communicate the assessment plan.

Baseline Evaluation of Assessment Practices and Syllabus Use

During the 2013-2014 academic year, undergraduate students ($n = 210$) registered for a research course through CALs at the University of Florida, and tenured and tenure-accruing faculty members who supervised undergraduate research for credit were recruited to complete brief online surveys administered through SurveyMonkey™. As shown in Table 1, the student survey items queried the college wherein research activities occurred, registered research credit hours, receipt of a syllabus, how final course grade was determined, and communication of research expectations (including work hours per week). The faculty survey tool assessed current rank, tenure department, and research/teaching/extension assignment. As shown in Table 2, the use of research course syllabi and assessment section of syllabi, if any, were also queried. Descriptive statistics were used to summarize the findings of the surveys.

Implementation and Evaluation of a S/U Research Course

In response to the baseline survey findings, a 0-3 credit research course assessed as satisfactory/unsatisfactory (S/U) with a recommended standardized course syllabus was implemented in CALs in the Fall of 2014. The course syllabus template "Supervised Research in Agricultural and Life Sciences" was developed to be adapted to any department in CALs. The course description stated, "Firsthand, authentic research in Agricultural and Life Sciences under

Table 1

Select items from the baseline evaluation of assessment methods used for independent research credit (undergraduate student survey).

Did you participate in supervised research during the fall 2013 semester for research credit?
How many research credits were you registered for during the fall 2013 semester?
Did you receive a syllabus from your research supervisor during the fall 2013 semester?
Did the syllabus include a set of scoring guidelines that indicated how your final course grade would be determined?
Of the following categories, which did the syllabus indicate that your grade would be based on?
<ul style="list-style-type: none">• Attendance• Exams• Quizzes• Participation• Other, please specify
Did your research supervisor meet with you and inform you of their expectations during the fall 2013 semester?
Were you informed by your research supervisor how your final grade would be assigned?
How many hours were you expected to participate in research activities each week by your research supervisor?

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Table 2

Select items from the baseline evaluation of assessment methods used for independent research credit (faculty survey).

Did you supervise one or more undergraduate students for independent research credit during the fall 2013 semester?

Did you distribute a syllabus to the undergraduate students registered for independent research credit with you?

If yes, please copy and paste the **evaluation section** of the syllabus you distributed to undergraduates into the text box below.

How many hours per week, on average, do you expect undergraduates to dedicate to research per credit hour?

the supervision of a faculty member. Projects may involve inquiry, design, investigation, scholarship, discovery, or application." Suggested course objectives included searching the scientific literature, lab safety (if relevant), recording research data, formulating a research problem, developing methodology, writing a research report, working in a team environment (if relevant), and the responsible and ethical conduct of research.

Identified students (n = 203) who were registered for research credit in fall 2015 were contacted through the CALS listserv and surveyed through Qualtrics® to re-examine methods to assess learning outcomes of undergraduate students who participated in research activities for course credit and use of syllabi. Additionally, students and faculty were queried regarding their awareness of the new 0-credit option. Survey items exploring student opinions regarding the 0-credit research option are shown in Table 3. A similar follow-up survey of students was conducted in the Fall of 2020 with an additional question exploring the impact of the COVID-19 pandemic restrictions on undergraduate research activities. Specifically, students were asked, "What was the nature of your research activities during the Fall 2020 semester? Responses included in-person laboratory, in-person community or clinic research, in-person outdoors, online/virtual, hybrid of in-person and online/virtual activities, or other. Recruitment for the final follow-up survey was through the weekly email to the CALS undergraduate listserv and directly to students enrolled in the CALS honors program (n = 31). Descriptive statistics were used to summarize the findings of the follow-up surveys.

Table 3

Survey items evaluating the 0-credit research course option.

Are you familiar with the 0-credit registration option when participating in research activities?

- Yes
- No
- I'm not sure

Please indicate your level of agreement with the following statements.*

- I am more likely to participate in undergraduate research with the option to register for 0 credits (students are registered for independent research and it appears on their transcripts as a course, but the student does not pay any course fees).
- Having a research experience and/or supervised research appear on my transcript is important to me.
- Independent research credit should be evaluated as Satisfactory or Unsatisfactory (S/U) compared to being graded (receiving a letter grade, i.e. A, A-, B+, etc.).

Please share any comments you have regarding your research experience during the fall 2015 semester and/or the 0-credit research option (students are registered for independent research and it appears on their transcripts as a course, but the student does not pay any course fees) for undergraduate research.

Note. *Statements were rated on a 5-point Likert scale (strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree)

Results

Baseline Evaluation of Assessment Practices and Syllabus Use

Of the undergraduates registered for undergraduate research in fall 2013, 63 (30% response rate) (47F, 16M) and 31 tenured and tenure-accruing faculty members from CALS who supervised undergraduate research for credit completed the surveys at baseline. A 2-credit hour course registration was most common (range 1-4 credits), and students were expected to participate in 4 hours of research activities per credit per week on average. Most students (67%) indicated their research activities were with faculty in CALS, whereas Liberal Arts and Sciences, Medicine, Dentistry, Health and Human Performance, Engineering, and Veterinary Medicine, among others, were also reported. Of the student respondents, 87% did not receive a syllabus, and of those who did, all of them reported that final grades were determined by attendance and participation. In responding to the open-ended comment item, one student confirmed that "Research was very independent and self-driven." Another student commented, "Research is much more intense and time-consuming than the credits signify. Based on the amount of work and stress that I had to put in, the 2 credits were very small." Yet another student noted, "I enjoy working in my lab. This semester I will be completing my 10th credit hour for undergrad research."

Faculty respondents represented every academic program in CALS except Statistics. Faculty expected

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undergraduates to dedicate an average of 4 hours per week to research for every credit hour enrolled. Faculty typically supervised an average of two students for independent research credit during the fall 2013 semester. Of responding faculty, 94% did not distribute a syllabus to the undergraduate students registered for independent research credit.

Implementation and Evaluation of a S/U Research Course

Post-implementation of the S/U research credit, 49 students (24% response rate) and faculty (n = 30) who supervised undergraduate research for credit completed the surveys through Qualtrics® in the fall of 2015. Most students reported being familiar with the 0-credit option (78%). Few students received a syllabus; however, they met with their research advisor or were informed of the expectations (91%). Most students *agreed* or *strongly agreed* that they were more likely to participate in research with a 0-credit option and that having “research” on their transcript is important, but fewer agreed that research should be evaluated as S/U (Table 4). Most faculty (75%) reported that they did not distribute a syllabus, and some were unaware that a template syllabus existed (38%); however, most of those who did use the CALS template (67%). Some faculty *agreed* or *strongly agreed* to future use of the template (38%), that undergraduate students are more accountable when registered for research credit versus volunteering (73%), and that research credit should be evaluated as S/U (54%).

In response to the longer-term follow-up study in the fall of 2020, 64% of the students (n=27) reported preferring a 0-credit option; only four students were unsure or unaware of this option. Receiving a syllabus continued to be uncommon; only three students reported receiving a syllabus describing the assessment criteria, i.e., S/U determination. All but one of the students were informed to the research expectations. Students averaged 5.1 ± 2.6 hours (range 3-10 h) of research per week, and students registered for the 0-credit option reported the highest research commitment at 8.0 ± 2.0 hours per week. Most students *agreed* or *strongly agreed* that having research on their transcript was important and were more likely to participate in undergraduate research with the option to register for a 0-credit option (Table 4). Most students preferred S/U vs. letter grading (Table 4).

Students were asked to share any comments they had regarding their research experience. One student

responded, “My research experience was very valuable to me, and I learned a lot about the research process. My PI [principal investigator] was very flexible and understanding.” Another student commented, “I have now registered for the 0-credit option for 2 semesters and I think it is the best option for undergrad research. Not having to pay course fees and avoiding potential excess credit hours are what make 0 credits sensible.” Yet another student stressed the advantages of a 0-credit option.

Personally, I felt that it was important for research to appear on my transcript, but I did not want to pay for it like another course...Research involvement is significantly different than school and traditional classes so having the 0 credit option is important.

Not surprisingly, research activities during the Fall of 2020 were primarily online/virtual or hybrid. Of the 23 students who responded to the items related to how COVID-19 impacted undergraduate research, five reported participating in only in-person laboratory activities, whereas the remaining respondents indicated online or hybrid research activities. Figure 1 displays CALS undergraduate research course registration by course credit from the fall of 2014 to 2020. Notably, the number of students registered for the 0-credit option was maintained in the fall of 2020.

Discussion

In agreement with the hypothesis, students enrolled in letter-graded undergraduate research courses were not formally assessed for knowledge or skill gain, but instead, grades were assigned based on attendance and participation. Prior to implementing the S/U 0-3 credit supervised research course, students had registered for as many as 10 credits over multiple terms. If such students received “A” grades, these research courses may have significantly contributed to elevating their grade point averages. Hence, implementing a S/U graded course was a logical solution to grade inflation.

Of interest, at baseline, when research courses were letter-graded, supervising faculty expected students to commit to 4 hours per week to research for every credit hour enrolled. This expectation did not decrease with the introduction of the 0-credit S/U research course. Instead, at 6 years post-implementation, students enrolled in 0-credit reported the highest time commitment to research, at 8 hours per week. However, this sub-sample was small and may not represent all the students registered for the 0-credit

Table 4

Undergraduate student opinions of 0-credit and grading post-implementation of a Satisfactory/ Unsatisfactory (S/U) graded undergraduate research course.

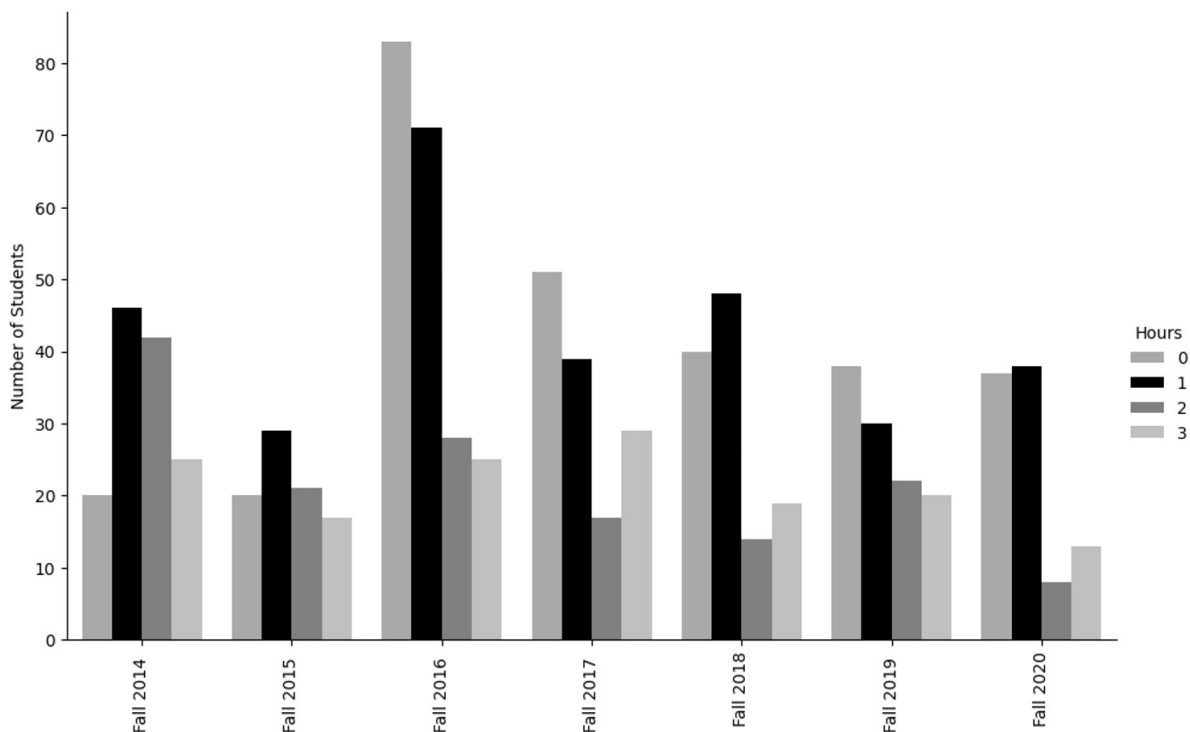
	Fall 2015*	Fall 2020*
I am more likely to participate in undergraduate research with the option to register for 0 credits.	58%	68%
Having a research experience and/or supervised research appear on my transcript is important to me.	89%	82%
Independent research credit should be evaluated as Satisfactory or Unsatisfactory (S/U) compared to being graded (receiving a letter grade, i.e., A, A-, B+, etc.).	47%	64%

Note. *Percentage of respondents that “Agreed” or “Strongly Agreed” with the statement.

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Figure 1

Undergraduate S/U (satisfactory/unsatisfactory) 0-3 credit research course registration in the College of Agricultural and Life Sciences by course credit from fall 2014 (first implementation) to fall 2020.



research course during the term surveyed or other terms.

A few supervising faculty provided their mentees with a syllabus pre- or post-implementation of the CALS S/U independent research course, but most did not. This finding may reflect the need for a cultural shift away from research assessment based on attendance and participation to one based on the rigorous assessment of knowledge and skill gain for either letter-graded or S/U courses. Providing a syllabus with details on the student outcomes to achieve a 'satisfactory' grade would facilitate effective communication between mentor and mentee. Assessment rubrics for evaluating undergraduate research have been developed for some time (Newell et al., 2004) and could be utilized in S/U graded research courses. The assessment plan requires defined goals with measurable criteria based on performance and judgment using multidimensional evidence (Woods, 2000). Perhaps, mentee-mentor models of independent undergraduate research courses, irrespective of the grading criteria, should be assessed as are many CURE courses, the difference being only the design of the experience – individual vs. classroom-based research activities.

In addition to learning outcomes, the assessment of independent undergraduate research courses ideally should also include the systematic collection of data on the wider impacts and outcomes, as are often collected on sponsored summer research experiences and CURE courses (Crowe & Brakke, 2019). Data of interest include the benefits of undergraduate research courses on the mentees, such as recruitment into graduate and professional programs, career trajectories, and success, but also outcomes for the research mentors, such as contributions to refereed

publications (Good et al., 2013), preliminary data for grant writing, and conference presentations. Additionally, data on possible unintended consequences of mentee-mentor models of independent undergraduate research courses and potential gaps or inequalities in research course participation are also needed to inform course and program quality improvement, respectively.

This study had some limitations. At baseline, only those students registered for letter-graded research course credit were surveyed. Many students who worked as research volunteers were not included in the surveyed sample, and these students may have responded differently to the survey items. Additionally, the recruitment strategy for the third survey in 2020 differed from the baseline, and initial post-implementation surveys directly targeting registered students, which may have contributed to the low response rate. Alternatively, the lower response rate for the 2020 survey may have been due, in part, to the general disengagement of students during the peak of the COVID-19 pandemic (Munsell et al., 2020).

For this study, faculty were not asked why they did not distribute a syllabus. For some faculty, it was because they were unaware of a standardized syllabus for use in undergraduate research courses. Alternatively, faculty may see the mentee-mentor research experience model as a very individual process not conducive to a standard syllabus vs. an experience that could and perhaps should result in the acquisition of a standardized set of measurable gains in research knowledge and skills. Workload and time constraints may have also been a factor – that is, if independent research course syllabi are not required for website posting or other department or institutional

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requirements as are other undergraduate course syllabi, it may simply be one less thing to do. Research is needed to elucidate faculty perspectives on the assessment of mentee-mentor-modeled undergraduate research courses. Specifically, there remains faculty and student disagreement regarding whether undergraduate research courses should be letter-graded or S/U, and thus, the reasoning supporting these conflicting positions requires exploration.

Conclusions

In the college of agricultural and life sciences examined in this study, formal assessment of undergraduate research coursework was lacking, and grades were determined primarily by attendance and participation. This practice may have contributed to inflation of grade-point averages, particularly for students taking such courses in multiple semesters. Following the implementation of an S/U research course, undergraduate student survey findings suggest that a 0-credit course option has advantages, allowing students to register for research but not pay additional tuition or exceed their course registration limits. Syllabi use for the S/U research course remained uncommon at the 6-year follow-up, and thus, additional steps are needed to ensure syllabi are made available to students registered for research courses to ensure assessment transparency. Further research is needed to explore faculty and student perspectives on assessment measures of skills and knowledge gains of mentee-mentor-modeled research courses and evaluation methods for assessing general research course outcomes.

References

- Adedokun, O. A., Zhang, D., Parker, L. C., Bessenbacher, A., Childress, A., & Burgess, W. D. (2012). Understanding how undergraduate research experiences influence student aspirations for research careers and graduate education. *Journal of College Science Teaching, 42*(1), 82.
- Auchincloss, L., Laursen, S., Branchaw, J., Eagan, K., Graham, M., Hanauer, D., Lawrie, G., McLinn, C., Pelaez, N., & Rowland, S. (2014). Assessment of course-based undergraduate research experiences: a meeting report. *CBE—Life Sciences Education, 13*, 29–40. <https://doi.org/10.1187/cbe.14-01-0004>
- Beck, J., Buckner, B., & Nikolova, O. (2007). Using interdisciplinary bioinformatics undergraduate research to recruit and retain computer science students. *ACM SIGCSE Bulletin, 39*(1), 358-361. <https://doi.org/10.1145/1227504.1227436>
- Carpi, A., Ronan, D. M., Falconer, H. M., & Lents, N. H. (2017). Cultivating minority scientists: Undergraduate research increases self-efficacy and career ambitions for underrepresented students in STEM. *Journal of Research in Science Teaching, 54*(2), 169-194. <https://doi.org/10.1002/tea.21341>
- Chang, M. J., Sharkness, J., Hurtado, S., & Newman, C. B. (2014). What matters in college for retaining aspiring scientists and engineers from underrepresented racial groups. *Journal of Research in Science Teaching, 51*(5), 555-580. <https://doi.org/10.1002/tea.21146>
- Crowe, M., & Brakke, D. (2019). Assessing undergraduate research experiences: An annotative bibliography. *Scholarship and Practice of Undergraduate Research, 3*(2), 21-30.
- Good, D. J., McIntyre, C. M., & Marchant, M. A. (2013). The USDA Scholars Program: Innovations in a summer undergraduate research program. *NACTA Journal, 57*(1), 62-70. <https://www.jstor.org/stable/10.2307/nactajournal.57.1.62>
- Gynnild, V. (2011). Student appeals of grades: a comparative study of university policies and practices. *Assessment in Education: Principles, Policy & Practice, 18*(1), 41-57. <https://doi.org/10.1080/0969594X.2011.535301>
- Haeger, H., Banks, J. E., Smith, C., & Armstrong-Land, M. (2020). What we know and what we need to know about undergraduate research. *Scholarship and Practice of Undergraduate Research, 3*(4), 62-69. <https://doi.org/10.18833/spur/3/4/4>
- Hess, J. L., & Whittington, M. S. (2003). Developing an effective course syllabus. *NACTA Journal, 23*-27. <https://www.jstor.org/stable/43765776>
- Moss, J. Q. (2011). An undergraduate summer research and mentorship experience for underrepresented students in the agricultural sciences. *NACTA Journal, 55*(1), 32-37. <https://www.jstor.org/stable/10.2307/nactajournal.55.1.32>
- Munsell, S. E., O'Malley, L., & Mackey, C. (2020). Coping with COVID. *Educational Research: Theory and Practice, 31*(3), 101-109.
- Newell, J. A., Newell, H. L., & Dahm, K. D. (2004). Rubric development for assessment of undergraduate research: Evaluating multidisciplinary team projects. *Chemical Engineering Education, 38*(1), 68-73.
- Nicholson, B. A., Pollock, M., Ketcham, C. J., Fitz Gibbon, H. M., Bradley, E. D., & Bata, M. (2017). Beyond the mentor-mentee model: A case for multi-mentoring in undergraduate research. <https://openworks.wooster.edu/facpub>
- Odera, E., Lamm, A. J., Odera, L. C., Duryea, M., & Davis, J. (2015). Understanding how research experiences foster undergraduate research skill development and influence STEM career choice. *NACTA Journal, 59*(3), 180-188. <https://www.jstor.org/stable/10.2307/nactajournal.59.3.180>
- Sears, C. R., Boyce, M. A., Boon, S. D., Goghari, V. M., Irwin, K., & Boyes, M. (2017). Predictors of student satisfaction in a large psychology undergraduate program. *Canadian Psychology/Psychologie canadienne, 58*(2), 148. <https://psycnet.apa.org/doi/10.1037/cap0000082>

UNDERGRADUATE RESEARCH CREDIT

Thiry, H., Weston, T. J., Laursen, S. L., & Hunter, A.-B. (2012). The benefits of multi-year research experiences: Differences in novice and experienced students' reported gains from undergraduate research. *CBE—Life Sciences Education*, 11(3), 260-272. <https://doi.org/10.1187/cbe.11-11-0098>

Vieyra, M., Gilmore, J., & Timmerman, B. (2011). Requiring research may improve retention in STEM fields for underrepresented women. *Council on Undergraduate Research Quarterly*, 32(1), 13-20.

Wilson, A. E., Pollock, J. L., Billick, I., Domingo, C., Fernandez-Figueroa, E. G., Nagy, E. S., Steury, T. D., & Summers, A. (2018). Assessing science training programs: Structured undergraduate research programs make a difference. *BioScience*, 68(7), 529-534. <https://doi.org/10.1093/biosci/biy052>

Woods, D. (2000). Team Building: how to develop and evaluate individual effectiveness in teams. Proceedings, AIChE Annual Meeting, Los Angeles.

Yaffe, K., Bender, C., & Sechrest, L. (2014). How does undergraduate research experience impact career trajectories and level of career satisfaction: A comparative survey. *Journal of College Science Teaching*, 44(1), 25-33.