Annual Assessment Report

Department of Physics

4 August 2023

The Department of Physics met on 26 April 2023. Assessment was one of the topics of discussion although the data presented herein were not. (Results of the senior exit survey were not yet available.) All members of the department attended this meeting: Julie Gunderson, Damon Spayde, John Steward, Todd Tinsley, and Ann Wright.

The Student Assessment Plan that was put into place in 2020 has the department assessing our fourth learning goal (DLG4) in AY 2022-2023:

> "Upon successful completion of the requirements of the physics major, students will be able to present scientific information clearly, logically, and critically, both orally and in writing."

Direct Assessment

The direct assessment of this learning goal was carried out by applying the "Communication Rubric" (Appendix D of the Student Assessment Plan) to two different classes: the spring 2022 section of PHYS 420 Electrodynamics and the spring 2023 section of PHYS 315 Modern Physics. Both oral and written communication were gauged in PHYS 420; only written communication was assessed in PHYS 315. PHYS 420 is an upper-level content course (one of the so-called "Big Four") and generally enrolls a mix of junior and senior physics majors. PHYS 315 is a sophomore-level course and provides the W2 opportunity in the Physics Department. PHYS 315 is a requirement for the PHYS major and minor so typically enrolls sophomore-level nascent physics majors as well as some upper-level students from other majors seeking a minor in physics. According to the Curriculum Mapping in the Student Assessment Plan both courses should allow students to demonstrate mastery of DLG4.

Oral Communication

The data shown in Figure 1 indicate that the majority of students in PHYS 420 successfully demonstrated mastery of the oral component of DLG4 with only one student earning a developing mark, and none receiving an introductory one. The course's instructor, Dr. Todd Tinsley, provides the following context for this assessment.

> "To help develop the students' skills toward mastery over the ability to communicate with evidence, organization, and enthusiasm in *oral communication*¸ I used a two-part assessment. The first was in daily group work where students had to work together and report out their approach to the class. All students did this well, earning at least "developing" on the department's Oral Communication rubric in appendix D of our student assessment plan. The second part was in a scaffolded term project that resulted in a 10- to 12-minute presentation to the class on an application of Electrodynamics."

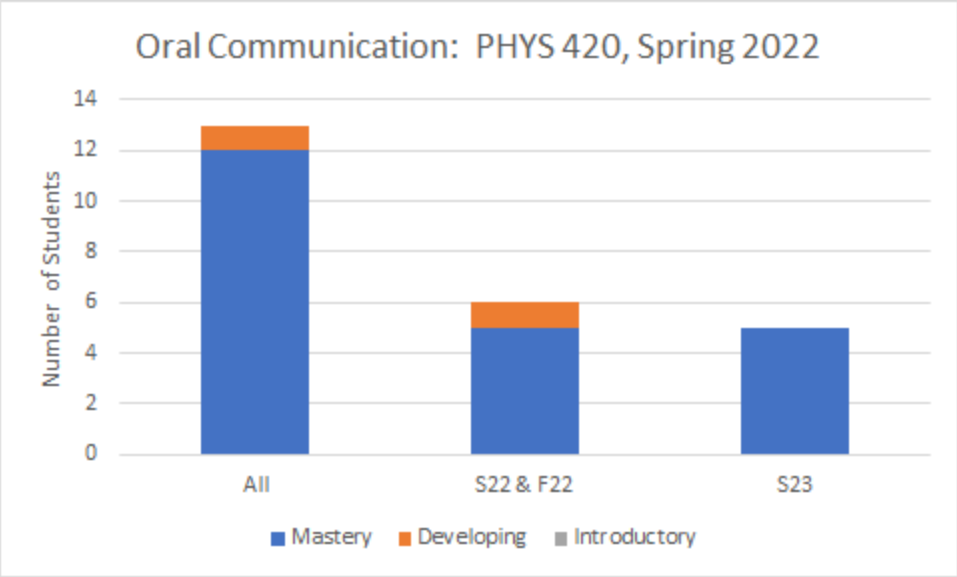

Figure 1 Direct assessment of DLG4's oral component from the spring 2022 section of PHYS 420 Electrodynamics. The stacked bar graph indicates the number of students achieving "Mastery", "Developing", or "Introductory" in DLG4. The categories along the horizontal axis correspond to all enrolled students ("All"), students graduating in spring 2022 or fall 2022 ("S22 & F22", i.e. senior-level physics majors), and students graduating in spring 2023 ("S23", i.e. junior-level physics majors). The difference in total numbers between "All" and the combination of "S22 & F22" and "S23" is due to the enrollment of a pair of junior-level students from other majors.

Written Communication

The data in Figure 2 also indicate that students in PHYS 420 demonstrated mastery of the written component of DLG4. Dr. Tinsley provides this explanation for the writing assessment in this course.

> "To help develop the students' skills toward mastery over the ability to communicate clearly, logically, and critically in *writing*, I assigned a problem approximately each week for a student to write up a formal solution in LaTeX. I would read that problem and give students comments on both their writing and the physics. If there were issues, students had to revise and resubmit to receive a passing grade on that assignment. I applied the written communication rubric to the weekly writing of my students near the end of the semester…"

The data on written communication skills from the spring 2023 section of PHYS 315 Modern Physics are shown in Figure 3. They create an interesting comparison with the PHYS 420 data. Only half of the enrolled students were perceived to have attained "Mastery" in this course. Three others attained "Developing" and one merely achieved "Introductory". (An argument can be made that the student achieving "Introductory" should not be included in this sample. That student failed to submit over half of the assignments used in this assessment and ultimately did not pass the course.) In this course the Communication Rubric was applied to student writing on lab reports. Students were required to write formal lab reports on two different experiments that were performed in class. They had the opportunity to turn in an ungraded draft of the first report for formal feedback prior to the submission of the final report.

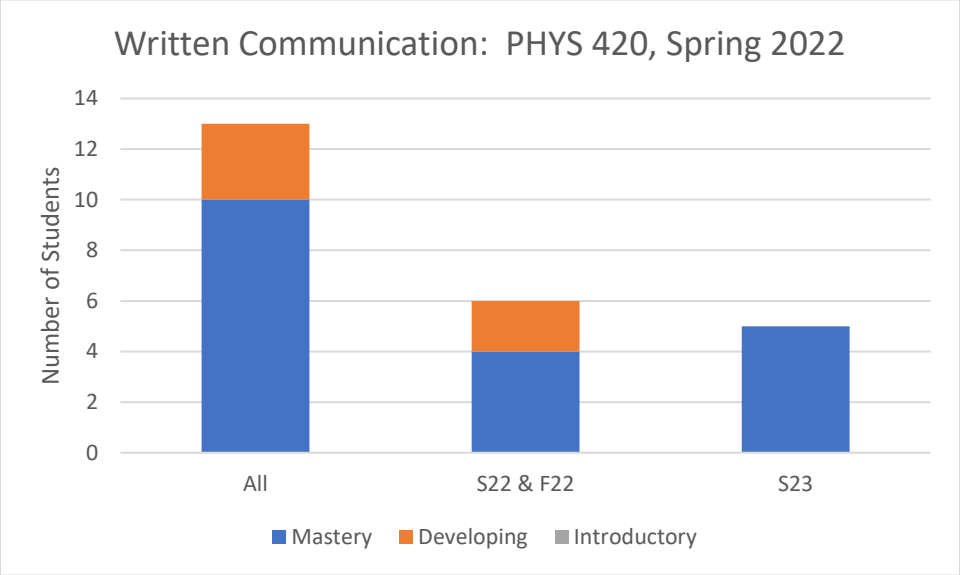

Figure 3 Direct assessment of DLG4's written component from the spring 2022 section of PHYS 420 Electrodynamics. The stacked bar graph indicates the number of students achieving "Mastery", "Developing", or "Introductory" in DLG4. The categories along the horizontal axis correspond to all enrolled students ("All"), students graduating in spring 2022 or fall 2022 ("S22 & F22", i.e. senior-level physics majors), and students graduating in spring 2023 ("S23", i.e. junior-level physics majors). The difference in total numbers between "All" and the combination of "S22 & F22" and "S23" is due to the enrollment of a pair of junior-level students from other majors.

The lower average score on the assessment in PHYS 315 is probably not too surprising. This is a sophomore-level course; the enrolled students are still working on their college-level writing skills. This interpretation is borne out in the data (at least to the extent one can formulate any reasonable

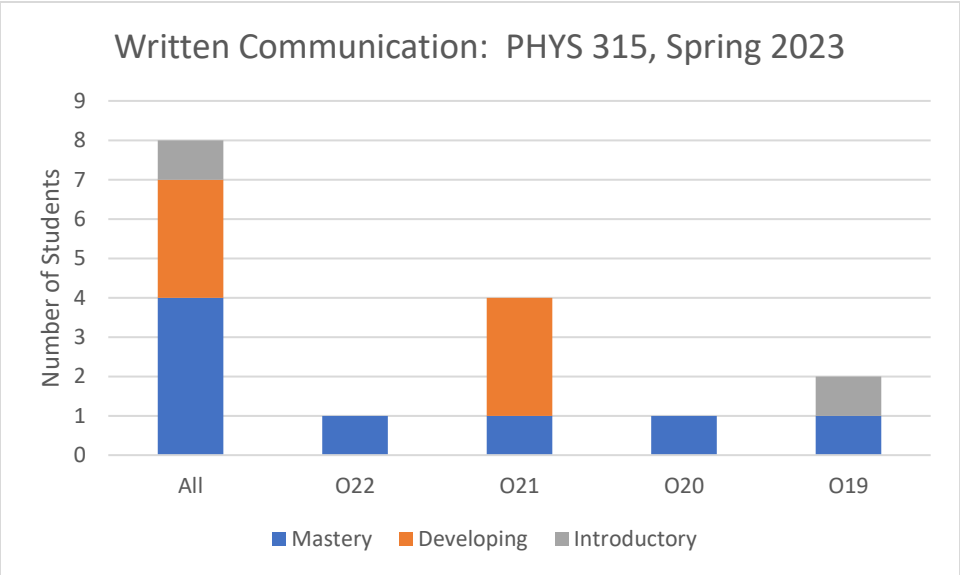

Figure 2 Direct assessment of DLG4's written component from the spring 2023 section of PHYS 315 Modern Physics. The stacked bar graph indicates the number of students achieving "Mastery", "Developing", or "Introductory" in DLG4. The categories along the horizontal axis correspond to all enrolled students ("All") and orientation year of each student ("O22", "O21", "O20", and "O19"). The primary audience of this course, sophomores, correspond to "O21".

conclusion based on a sample size of eight). The data are broken down by the year the student enrolled in the college (orientation year). The sophomores in this section would have orientation years of 2021. All three of the "Developing" scores came from this group. This may suggest that we need to revisit our curriculum mapping in the student assessment plan and put in place different expectations for achievement for this course.

Indirect Assessment

The indirect assessment of DLG4 comes from question 9 of the department's exit survey sent to all graduating seniors (Appendix F in the Student Assessment Plan). This survey is sent out towards the end of the academic year. Participation in the survey is encouraged but voluntary. The response rate in 2023 was particularly low so the responses from the last three years – 2021, 2022, and 2023 – were aggregated to get a reasonable set of responses. Respondents are asked to score their responses to a set of three positive statements about communication skills on a five-point scale: Strongly Agree, Somewhat Agree, Unsure, Somewhat Disagree, and Strongly Disagree. The results from the last three years are shown in Figure 4.

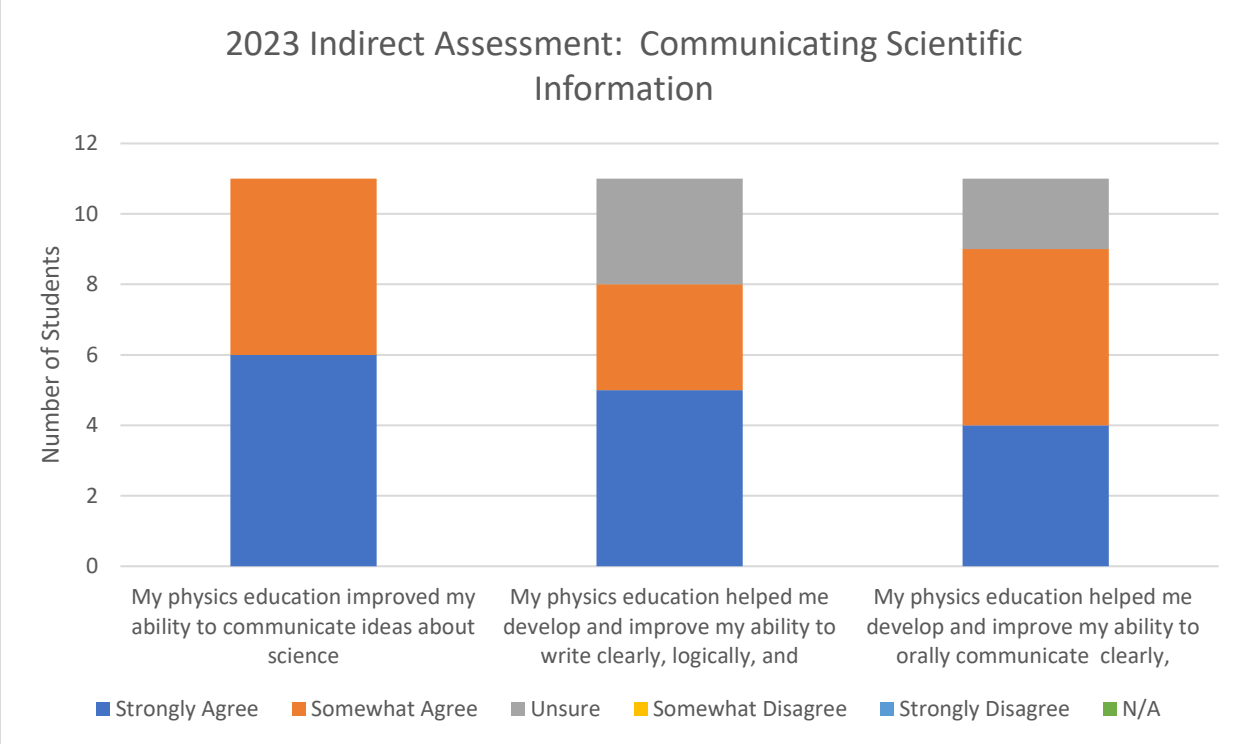

Figure 4 Indirect assessment of DLG4. Data are aggregated voluntary responses from graduating senior physics majors for the years 2021, 2022, and 2023. Respondents indicate their level of agreement with each of three positive statements on a five point scale.

There are no respondents that indicated "Somewhat Disagree" or "Strongly Disagree" to any of the three positive statements. There are a total of three "Unsure" responses. The remainder are all "Strongly Agree" or "Somewhat Agree". This is a positive sign that physics majors leave the institution feeling like their communication skills have been improved by the experience.

Conclusion

The data do not display any red flags of significant numbers of students failing to achieve DLG4 during their time at Hendrix. The interesting comparison between a sophomore-level (PHYS 315 Modern Physics) and upper-level course (PHYS 420 Electrodynamics) suggests a few things.

1. It may be necessary to revisit the Physics Department curriculum map and revise expectations for PHYS 315.
2. Instructional staff may need to provide additional writing instruction in PHYS 315 to bring more students up to the "Mastery" level. Given the evidence that almost all physics majors have achieve "Mastery" by the time they graduate, this may not be the best conclusion to draw.
3. The department may need to provide opportunities for more extensive writing at the upper-level, comparable to the lab reports of PHYS 315, to more thoroughly probe their writing at the time of graduation. This may result in a more accurate, nuanced comparison.

The department will take up these questions early in the 2023 academic year.