Teaching Tips/Notes NACTA Journal

**Performance Task Activity for a Soil Fertility Course**

Soil Nutrient Relationships is a junior-senior level course at The University of Nebraska-Lincoln taken by Agronomy majors and minors (who typically are majoring in Agricultural Business/Economics or Mechanized Systems fields). The course is offered once a year and averages 65 students. Students have three 1-hr large group sessions used for lecture, discussion, example problems, and case studies as well as one 2-hr session of 20-24 students to work on relevant skills (e.g. soil sampling, soil test interpretations) per week (*https://soilscropsteachingmaterials.files.wordpress.com/2019/06/agro-366-short-syllabus.pdf*).

The student learning outcomes for the course include:

- Students will be able to formulate evidence based nutrient management plans for crop production that considers economics and the environment
- Students will be able to integrate the four R scientific principles in nutrient management decision making plans. [*The 4 Rs are Right Source, Right Rate, Right Time, and Right Place (*IPNI, 2018*).]*

The course was designed following the Backward Design approach (Wiggins and McTighe, 2001) with a semester long integrated nutrient management project used as a summative performance task activity (PTA) that is aligned with learning outcomes. Use of a PTA allowed instructors to frame course content in a practical setting, which increases student engagement in and ownership of course content, and ultimately increases retention of content knowledge. Other instructors have also found that student motivation and engagement was improved for large courses when active learning projects were employed (Huguet et al. 2019).

Students work in groups of three to four students to develop an integrated soil fertility management plan for a site of their choosing. The sites are typically crop production fields owned by one of the group members or their families. Students are tasked with:

- Researching and gathering relevant information on the soils, climate, and land use history.
- Evaluating the efficiency of the current production practices.
- Identifying concerns and setting measurable management, economic, and/or environmental goals for the site.
- Developing or revising the nutrient recommendation while integrating the four R nutrient management principles.
- Proposing monitoring plans to measure efficacy of the recommendations.
- Justifying, with evidence, the recommendations framed within the set goals and the surrounding environment, current economy, and other factors.

The above tasks are assessed via written and oral (poster) presentations from student groups. The written portion is typically 5-8 pages of text with lengthy data appendages and graded by the course instructors. The posters are typically 1 x 1 meter and presented during a public session to UNL faculty, staff, and student guests who have been invited to score the

presentations and posters. Rubrics for the paper and poster include assessment of the justification, evidence, overall organization, clarity of the writing, and overall quality of the proposal.

The PTA is introduced in the second week of a full semester course. Students are given the flexibility to choose their work groups and the study site. Instructors only provide students with written directions and a copy of the rubrics that will be used to score written and oral presentations of the management plan (*https://soilscropsteachingmaterials.files.wordpress.com/2019/06/agro-366-pta.pdf*). However, instructors take many steps to assist students in developing plans that are accurate and useful, well justified, and representative of higher order thinking. These steps include requiring submissions every few weeks throughout the semester. This allows students to review feedback and revise their plan (and their writing) as well as facilitating efficient time and project management for students. In addition to instructors reviewing student work, a peer review process is used for both the written and oral presentations. This allows an additional source of feedback for the students, gives the reviewers a sense of what works and doesn't work from reading other papers/posters, and builds learners confidence (Guilford, 2001). A handout on the decision making process is also provided to students mid-semester with associated in-class activities. Finally, the instructor team sits down with each group twice per semester; these meetings have been useful to help students sort through information and determine the most important details to report and then discuss how to transfer ideas from in their head to on paper in order to improve the written justification of their proposals. Instructors also value these sessions as it provides instructors an opportunity to observe learners engaged in higher order thinking to resolve such a complex subject. This mode of instruction falls more into "academic coaching," a teaching style gaining in interest for the modern generation of students (Barkley, 2011). Students are allowed to practice and improve at their own pace while being advised (or coached) rather than taught.

There are many learning benefits to students completing this PTA, primarily, that it elevates their understanding of course content as it is applied to a real world situation. Research has indicated that students self-report in surveys that their skills and knowledge were improved through classroom use of problem-based learning (Hawley, Hall, and Pate, 2017; Mahoney and Retallick, 2015; Bott and Cortus, 2014). Students in AGRO 366 were surveyed and asked to rate how helpful (1 = very unhelpful, 7 = very helpful) each course activity (e.g. lecture, reading, case studies, PTA) was toward achieving the course learning outcomes. The PTA scored most highly amongst respondents at 6.27. In another question, 35% of respondents chose the PTA in response to "The component of AGRO 366 that will be most important to my future work is _____". Other options were the other course assessment activities (e.g. tests, case studies, lab portfolio).

There are also several ancillary skills learned and developed beyond course content while working on the PTA which include information gathering and sorting, teamwork, writing and revising, and oral communication. All of these ancillary skills have been identified as part of our Program Learning Outcomes and as desirable student skills by employers (Svacina and Barkley, 2010; Smith et al., 2014). Furthermore, the process of developing a recommendation allowed students to practice critical thinking and systems thinking. Many students comment on how taking the time to analyze current practices led to discoveries of inefficiency in the current

agronomic practices (such as crop selection, irrigation scheduling, spatial management, liming program, fertilizer rates, and so on). Systems thinking is becoming increasingly recognized as an important skill (Booth Sweeney and Sterman, 2007). As part of the PTA, students are tasked with thinking about the interaction of factors such climate, equipment availability, and commodity market in making decisions about soil management.

In summary, instructors for this course determined that 'ability to apply knowledge to everyday tasks of the profession' was a key learning outcome for the course and, as such, developed the course around completion of a PTA that reinforced those abilities. In addition to deeper learning of course content, students also developed additional skills of teamwork, writing, and critical thinking. The course will proceed in coaching students through such activities as it provides a great way to engage students in a large enrollment course and prepare them for the workforce using real-life situations.

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**Submitted by:**
Meghan Sindelar, Martha Mamo and Mark Keck
University of Nebraska – Lincoln
Lincoln, NE