

**How phenomenal are we at agriscience phenomenon?
An Instrument for Reflection on Phenomenon Based Instruction in Agriscience**

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Introduction/need for innovation

Despite the passage of 10 years since the release of Next Generation Science Standards (NGSS) (National Research Council, 2012), there is limited research relating to implementing phenomenon based instruction in agriscience classrooms. Phenomena is defined here as “observable events that occur in the universe and that we can use our science knowledge to explain or predict” (*Using Phenomena in NGSS-Designed Lessons and Units*, 2016). Phenomenon based instruction allows learners the opportunity to experience authentic context for their learning, in this case, agricultural applications of science standards. The Phenomenon in Agriscience Teaching instrument (PAT) field tested in this innovative idea aims to have dual purposes in the intention to implement phenomenon based instruction in agriscience: (a) teacher/preservice teacher engagement in metacognitive process during learning events and (b) facilitator program planning and evaluation.

In consideration of planning for adult learning programs, a coalescence of Universal Design for Learning (UDL) and andragogy support the PAT as a valuable innovation for all teachers and preservice teachers (Cook & Rao, 2018; Fornauf & Erickson, 2020). Engagement in metacognition is supportive of andragogy, as it honors lived experiences of adults and provides opportunity for learners to orient to their context (Knowles et al., 2015). UDL *Checkpoint 9.3 - develop self-assessment and reflection* charges facilitators with providing opportunities for metacognitive reflection (*UDL: The UDL Guidelines*, n.d.). Utilizing a tool like the PAT can provide adult learners opportunity to engage in self reflection and planning for next steps as part of their personal growth. Additionally, beyond the immediate benefit to the teacher using the PAT, their exposure to the UDL methodology of a self-reflection inventory may encourage teachers to try UDL in their own classrooms (Craig et al., 2022; Fornauf & Erickson, 2020).

How it works/methodology/program phases/steps

It is recommended that facilitators (teacher educators and/or professional learning leaders) administer the PAT to participants (teachers and/or preservice teachers) prior to engaging in a learning program/event focused on phenomenon in agriscience instruction. After administering the PAT, two steps should occur. First, the participant should reflect on their responses and develop a personal learning intention for the event/program. Next, the facilitators should review the data, and then revise and refine the planned learning experience based responses. Finally, it’s recommended for participants and facilitators to return to the PAT at the conclusion of the learning experience. Participants should reflect on their learning and plan for next steps, and facilitators should evaluate their program and plan for future programs.

Results to date/implications

The PAT was field tested as a Google Form with 39 teachers attending two select agriscience sessions at the California Agricultural Teachers Association Conference. Teachers in the sample ranged from just completing student teaching, to 30 years of service (M = 5.6 years, SD = 7.0), with the half being 0-3 years (51%), and the other half split between 4-7 years (25.6%), and 8 or more years (23.1%). The reliability of the PAT exceeded Likert’s recommended threshold of $\alpha = .9$ (Likert, 1932), and also is aligned with recent literature encouraging researchers to reduce error (Strong, 2023). From the facilitator perspective, the data

collected allowed for real time adjustments of the professional session, and will inform next steps for teacher preparation on practicing teacher professional learning sessions.

Table 1

Teacher's Implementation Inventory of Phenomena in their Agriscience Classroom (n = 39)

Item	M	SD
I can plan lessons with agriscience phenomena.	4.8	1.2
I can explain what phenomena is in the context of an agriscience classroom.	4.8	1.1
I can give examples of agricultural phenomena in the agriscience classroom.	4.6	1.2
I teach lessons that are driven by phenomena.	4.5	1.3
I can give examples of how I use phenomena in my daily teaching in the agriscience classroom.	4.5	1.3
I can coach another teacher/student teacher to use phenomena in the agriscience classroom.	4.1	1.5
I can list examples of sources for where to find phenomena for my agriscience classroom.	4.0	1.4

Note. Reliability $\alpha = .93$. Responses coded as 1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = neither agree nor disagree, 5 = slightly agree, 6 = agree, 7 = strongly agree.

Future plans/advice to others

The sampling techniques in this field test limit generalizability of the data itself. However, the findings of the field test of the PAT as a reliable instrument warrant further study, as the possible implications for advancing phenomenon based instruction in agriscience could be tremendous. *Researchers* should test the PAT with a variety of populations, as well as explore teachers' perceptions of the PAT and its usefulness as a metacognitive support and UDL teaching method. Beyond study of the reliability of the PAT, data collected from the instrument (or revised instrument) can serve to identify needs for program development. *Practitioners* could think creatively beyond the one conception of the PATs use that has already been discussed here. Users are encouraged to analyze and plan for their context, with specific consideration to advancing implementation of phenomenon based instruction in agriscience in their specific population of adult learners. Digital instrumentation is recommended for the PAT, especially when facilitators intend to utilize the data in real time to adjust/refine their program based on teachers' needs. For practitioners, Google Forms offers many benefits including affordability, and a variety of options for analysis and reporting including ready made graphs and the capacity to export to spreadsheets for user generated reports, visuals, and statistical analysis. Additionally, an instrument distributed in Google Forms can be set to send the participants a copy of their responses, which could be valuable for the participants' metacognitive process.

Costs/resources needed

Direct costs associated with utilizing the PAT relate to duplication in hard copy (if used), or subscription to platforms for online administration (if applicable). Additional costs relate to some statistics packages associated with analyzing data if low/no cost options like Excel or Sheets are not appropriate and/or desirable. There is no cost with licensing to use the PAT. *Indirect costs* can include time to analyze data (varies by hourly rate). With only seven items, analysis of the PAT data can take less than one hour's time for those skilled in the data analysis with the statistics package of their choice. Administering the PAT takes less than five minutes, which will need to be accounted for in planning the facilitators agenda of events.

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