Variation in Student Engagement between Hands-on & Minds-on Lessons When Learning about Cover Crops

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Introduction

There are very limited resources available to teachers for cover crop education. It is important to educate future farmers on the benefits of cover crops so that they are more likely to plant them in the future. According to the USDA as of 2017, 15.4 million acres have cover crops. The goal is 100 million acres planted with cover crops by 2025 (Wallander et al., n.d.).

4-H project books are a collection of activities for students to do year-long projects to present at county and state fairs. The 4-H *Cover Crop Science* project book consists of 11 lessons that cover the basics of agriculture and cover crops. These lessons include information on crop rotation, soil erosion, pollinators, and harvesting. This study focuses on evaluation of Lessons 1A: A Plant Primer, 1B: Cover Crops in the Rotation, 1C: Planting & Harvesting Practices, 2A: Reducing Soil Erosion and 2C: Pollinator Services.

This study examines whether students are more engaged in hands-on activities or minds-on activities. A *hands-on* activity is an activity involving manipulatives. A *minds-on* activity is an activity that does not use hands-on manipulation. Examples of hands-on activities included a flower dissection, soil erosion boxes, and a sorting activity using rice, beans, and oregano to demonstrate the harvesting process. The minds-on activities used images of different flowers and their pollinators, career sorting posters, and a crop rotation matching game. Hands-on engagement in learning is typically considered to be more desirable because it fosters active construction of knowledge that is more long-lasting and connected to prior knowledge structures (Bodner, 1986; Hein, 2016).

Research Question

Are students more engaged in hands-on activities or minds-on lessons when learning about cover crop science?

Methodology

Throughout the course of this research, we used the iterative curriculum design framework (Guru, 2017; Figure 1).

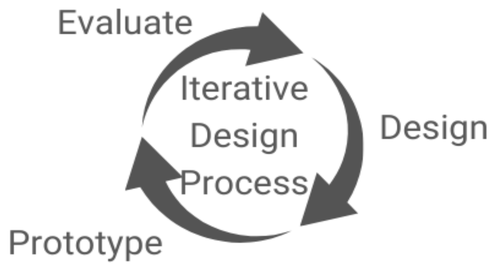

Figure 1. Iterative design process through which lessons were evaluated.

Using a validated survey created by Chung (2016), we administered a survey of student engagement *Cover Crop Science* lessons.

Phase 1 Data Collection & Analysis

After the first 7 teaching iterations, we collected engagement data and estimated amount of time spent hands-on. A regression analysis was performed to see if there was a significant relationship between time spent hands-on and engagement.

Phase 2 Data Collection & Analysis

To more precisely compare engagement during hands-on and minds-on lessons, we changed data collection procedures before teaching iteration 8. A Wilcoxon signed-rank test was performed to directly compare student's engagement between minds-on and hands-on lessons. This statistical test was used due to the small sample size in these teaching iterations (#8: N = 12, #9: N = 7).

Results

In Phase 1, the results of the regression were significant ($p < 0.001$) for teaching iteration 1 (Figure 2). The results show that the minds-on activities had a greater total engagement score than hands-on activities. For teaching iteration 2, the results of the regression do not show a significant relationship between engagement and hands-on time (Figure 3).

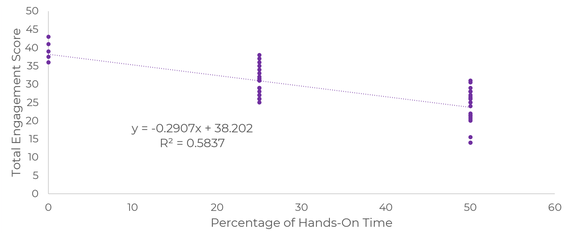

Figure 2. Engagement levels for teaching iteration one based on percentage of time spent on hands-on activities. The minds-on activities were significantly more engaging for this iteration ($p < 0.001$).

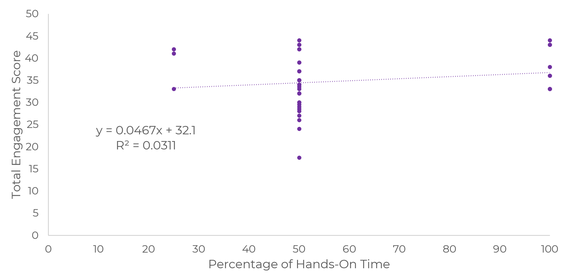

Figure 3. Engagement levels for teaching iteration two based on time spent on hands-on activities. This teaching iteration did not have a significant difference in engagement.

In Phase 2, Wilcoxon signed-rank tests indicated that there was no statistically significant difference in engagement during teaching iteration 8 between minds-on and hands-on activities.

Discussion

This evaluation of lessons from the *Cover Crop Science* project book indicate that learning context likely influences the effect that hands-on lessons has on student engagement. During teaching iteration 1, the minds-on activities were found to have higher total engagement than hands-on activities. However, in teaching iterations 2, there was not a significant relationship between hands-on time and engagement. This was observed again when we directly compared engagement during hands-on and minds-on activities. This difference is likely due to the contexts in which activities were implemented. For example, minds-on activities tend to have more explicit instructions, while instructors were more experienced at administering the hands-on activities as the study progressed. These factors might have combined to lead to more engagement early in the study for the minds-on activities. Nonetheless, this study highlights the importance of considering the influence of hands-on/minds-on time and student engagement, especially when learning cover crop science, for which many students are unlikely to have foundational knowledge.

Future Directions

There are multiple teaching methods, including hands-on and minds-on activities, used in the *Cover Crops Science* 4-H project book to encourage generational change among future farmers toward planting of cover crops. This research will help to contribute to the national adoption of the *Cover Crop Science* 4-Hproject book.

Acknowledgements

IPREFER is supported by Agriculture and Food Research Initiative Competitive Grant No. 2019-69012-29851 from the USDA National Institute of Food and Agriculture. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

We would like to thank the students who participated in the lessons and surveys throughout the course of this research

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