Research Poster

Evaluating Student Learning Outcomes in an Agricultural Biology Course

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Introduction

Agricultural science education pedagogy in the United States is increasingly expected to demonstrate holistic relevance, extending beyond workforce preparation to include measurable impacts on core academic science proficiency (Knobloch & Wang, 2024). In Illinois, the state standards were recently updated to allow for agriculture education courses to count as science courses for graduation requirements. To increase enrollment in agricultural education courses while addressing traditional science topics, an Agricultural Biology inquiry-based course was designed. The course follows Next Generation Science Standards (NGSS) and the storylining approach to inquiry-based learning to teach biology concepts in an agricultural context.

Theoretical Framework

Situated Cognition Theory argues that learning occurs best when it is paired with real-world situations (Brown et al., 1995). A learner is more likely to understand an issue or concept when it is learned in relation to specific activities (Jenlik, 1989). Knowledge can not be separated from the context of its use. In the context of Agricultural Biology, Situational Cognition Theory suggests that students are more likely to learn biology concepts when situated in specific contexts, such as agriculture. Our research questions are:

1) Do students enrolled in an Agricultural Biology course demonstrate comparable science learning outcomes to their peers in traditional Biology courses?
2) Do student outcomes in Agricultural Biology differ by school context, student demographic characteristics, or teacher experience?

Methodology

The Agricultural Biology curriculum was implemented in 20 classrooms across 17 Illinois high schools. The teachers implementing the courses met monthly with one of the curriculum developers for training on the storylining methodology and to share and work through implementation challenges. A total of 6 teachers had taught the course the previous year, and 14 were teaching it for the first time.

To assess and compare the academic outcomes of students enrolled in Agricultural Biology versus a traditional Biology course, we used a quasi-experimental, non-equivalent control-group design (Creswell & Creswell, 2018). Two test developers who designed the Illinois standardized test for science, the Illinois Science Assessment (ISA), created a four-part practice life sciences assessment in the same format as the ISA, following NGSS standards. Two of the parts were related to general life science/biology concepts, and two were designed around agricultural biology concepts. The exam included 28 multiple-choice and short-answer questions and also asked demographic questions for comparison. It was administered to students in Agricultural Biology and in Biology 1 (or equivalent) at participating schools.

Across the 17 schools, 294 students in Agricultural Biology and 528 students in traditional Biology completed the life sciences practice test in April 2025. The test was administered by the class teachers and scored by the test designers. The test results were analyzed using descriptive statistics and both univariate and two-way ANOVA to examine the effects of course type, student demographics (race, gender), school type, and teacher experience on total test scores. Exploratory comparisons by instructional year and school were also conducted to assess variability in implementation fidelity and learning outcomes across sites.

Results

The descriptive analysis revealed the sample was evenly distributed by sex (49.3% male; 49.0% female), and primarily composed of 9th and 10th-grade students (89.3%). The racial and ethnic breakdown included .2% Asian, 22.5% Black, 58.4% white, 4.4% American Indian,

12.4% more than one race, and 6.8% Hispanic. Across all participants, the mean total score on the assessment was 10.75 (*SD* = 5.12) out of 32.

Independent-samples *t* tests were used to compare science assessment scores by course type and teacher experience; two-way analyses of variance (ANOVA) were conducted to examine interactions between course type and student demographic and school characteristics. As shown in Table 1, there was no significant difference in science assessment scores between students enrolled in Agricultural Biology and those in traditional biology courses. No significant interactions were observed between course type and student gender, race, or grade level; however, significant effects were observed for teacher experience and school context. Teachers in their second year of teaching Agricultural Biology had students who scored higher.

Table 1

Summary of Statistical Tests Examining Course Type, Interaction, and Contextual Differences in Science Assessment Scores

Comparison	Df(df_1, df_2)	Test statistics	*p*
Course type(AgbioVsBio)	820	$t = -1.11$	.269
Course × Gender	2, 816	$F = 0.36$	.700
Course × Race	5, 810	$F = 2.10$	.063
Course × Grade	3, 814	$F = 1.39$	.246
Teacher experience	292	$t = -2.95$	.003
Course × School	13, 791	$F = 3.76$	< .001

Conclusions

The results indicate that students enrolled in Agricultural Biology performed comparably to students in a traditional Biology course on a practice version of a state standardized science assessment. No significant differences in performance were observed across gender, race, or grade level, suggesting equitable learning outcomes across diverse student demographics. While overall performance did not differ by course type, notable variation was observed across schools and the number of years of teaching Agricultural Biology (first vs second). This could suggest that instructional experiences, curriculum familiarity, and implementation fidelity may influence student achievement.

Our study does have limitations. The implementation of the Agricultural Biology curriculum and other Biology curricula was not consistent across sites. Not all teachers covered the same material; however, all Agricultural Biology instructors volunteered to teach the course, which might not be the same for all Biology instructors. The practice exam was a shorter version of the ISA exam, and full version results may lead to different student outcomes.

Implications

While some may argue that a biology course with a specific subject content (such as agriculture) may not provide a broad enough experience to successfully learn and apply scientific information, our study found no significant difference in test scores between students in Agricultural Biology and those in traditional Biology. The lack of a significant difference in scores suggests that students in Agricultural Biology courses are just as prepared to apply NGSS science standards as students in traditional Biology courses, and Agricultural Biology is a competent alternative to traditional Biology.

References

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