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Cultivating the Future Agricultural Workforce through Interdisciplinary Innovation

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INTRODUCTION & AIM

As agricultural science and technology undergo a rapid, interdisciplinary transformation, the industry faces a critical challenge: an aging workforce that often maintains traditional perspectives. To meet the growing demands of a global society, it is essential to prepare a new generation of producers capable of navigating swift shifts in agricultural practices. Modern advancements increasingly rely on a fusion of agricultural, chemical, environmental, industrial, and mechanical engineering—disciplines deeply rooted in chemistry, physics, and mathematics. However, the interconnectivity of these fields is frequently under-communicated to aspiring students.

Often the interdisciplinary aspects and interconnectivity of STEM disciplines is not well communicated to the aspiring students. This is currently being done at undergraduate or graduate level education. However, with changing educational fields and quickly growing interdisciplinary nature of various scientific and engineering fields and industrial sectors, it is a must to communicate these advances to students at much earlier stage so that they are prepared for higher studies. This lack of knowledge or understanding is more prevalent in students from underrepresented communities and groups including women and minorities.

Previous studies reported the differences in knowledge and perceptions of agriculture in rural and urban inner-city high school students (Frick et al., 1995) and the differences between perceptions and knowledge about agriculture based upon the location of the high school and concluded that limited contact agriculture and little or no agricultural education results in the lack of an agricultural knowledge base (Smith et al., 2009). Cosby and colleagues (2022) identified the persistent challenges of agricultural literacy and suggested to include education about agriculture in middle school so that students are acquainted with knowledge about agriculture. Developing agricultural literacy in school-aged children through formal education is critical. Similarly, to develop a well-informed workforce with transdisciplinary skills, research and Extension experiences can be provided to undergraduate students. REEU programs have been identified as high impact learning practices for STEM disciplines (Linn et al., 2015).

The main objectives of this project were to provide highly immersive, informative, and experiential learning to high school students about the interdisciplinary aspects of water, health, energy, environment, and land sustainability as related to agricultural infrastructure and to instill positive attitude and build confidence towards various scientific and engineering professions. The purpose of this study was to explore the knowledge levels of high school students on the interdisciplinary aspects of agricultural disciplines and evaluate their learning experiences during a 2-week experiential learning program (called WAMS) designed and executed for this purpose.

METHOD

A questionnaire was made available to the participants to provide feedback regarding their learning experiences during the 2-week experiential learning program in summer. The questionnaire consisted of the following structure to allow for open ended questions and voluntary feedback. The questions were focused on the overall program, program content (introduction/overviews of engineering and scientific disciplines/professions; exercises; field trips; and lectures. Questions were also included to get responses regarding the appropriateness and suitability of topics. Finally, participants were asked to report their perceived impact on learning of the interdisciplinary topics covered during the program.

The data from the program were collected using the questionnaire with open-ended questions to encourage open (truthful and accurate) responses. The questions were made simple so that high school students could understand. For this reason, the data were considered to be consistent and reliable. We also provided a psychometric survey tool (Likert scale) used to measure respondents' attitudes, preferences, or subjective feelings by asking them to rate their level of agreement with a series of statements. We analyzed the students' responses to the open-ended questions into a word processor and reported the outcomes of one of the Likert scale questions as an example (see **Table 1**) .

RESULTS & DISCUSSION

The program included short lectures and relevant hands-on learning activities including computer simulations, laboratory testing and prototype development and testing. Field trips, professional development lectures as well as higher education previews of various scientific and engineering disciplines were also included. Student participants mostly agreed that this program has enhanced their understanding of the STEM disciplines and their importance in agriculture and relevant industries (see **Figure. 1**). Participants also agreed that the program has provided opportunities to explore some of fundamental concepts bridging the agricultural sciences and engineering disciplines and has offered clarification for future studies and careers.

Learning Assessment:	Very Little	Little	A Good Bit	A Great Deal
How much did you learn because of this program	1	2	3	4
(A) Food-Energy-Water-Land Nexus for Agriculture				
Before WAMS program	1	2	3	4
After WAMS program	1	2	3	4
(B) Renewable Energy Integration in Agriculture				
Before WAMS program	1	2	3	4
After WAMS program	1	2	3	4
(C) Water Quality and Quantity				
Before WAMS program	1	2	3	4
After WAMS program	1	2	3	4
(D) Innovative Agricultural Circular Bioeconomy				
Before WAMS program	1	2	3	4
After WAMS program	1	2	3	4

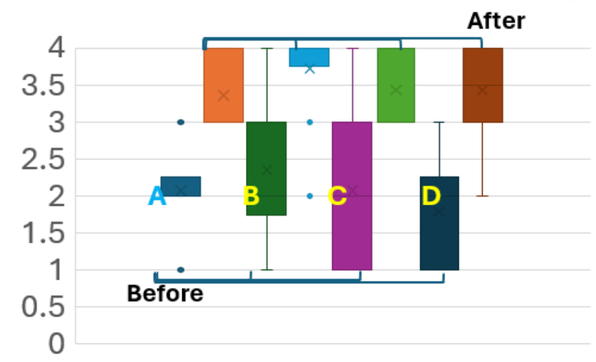

Figure 1. A summary of results highlighting the extent of knowledge levels and learning through the WAMS program: Topic A - Food-Energy-Water-Land Nexus for Agriculture; B - Renewable Energy Integration in Agriculture; C - Water Quality and Quantity; and D - Agricultural Circular Bioeconomy. Learning in the program:1 – very little; 2 – little; 3 – A good bit; and 4 – A great deal

CONCLUSION

This study highlighted the challenges and opportunities in developing a workforce capable of managing sustainable agricultural landscapes and presented the outcomes of an educational program that provided high school students with hands-on opportunities to explore the diverse scientific and management disciplines shaping the industry. The study focused on the learning experiences of STEM topics of the participants and the implications of educational activities on student learning experiences. Future project reports will showcase student perceptions before and after participation, demonstrating how experiential learning can successfully shift viewpoints toward a more technological and sustainable future. These ongoing efforts provide vital insights into the educational frameworks necessary to complete the transition to a modern agricultural workforce.