Digital Agriculture Summer Camp: A Comparative Analysis of the First and Second-Year Camp Participants' Knowledge and Postsecondary STEM Interests

Carly Altman
Middle Tennessee State University
651 Founders Lane
Murfreesboro, TN 37132
ca5i@mtmail.mtsu.edu
(404) 915-6362

Dr. Chaney Mosley
Middle Tennessee State University
651 Founders Lane
Murfreesboro, TN 37132
chaney.mosley@mtsu.edu

Dr. Song Cui
Middle Tennessee State University
651 Founders Lane
Murfreesboro, TN 37132
song.cui@mtsu.edu

Introduction

Science, technology, engineering, and mathematics (STEM) education have provided interdisciplinary connections to agriculture, food, and natural resources (AFNR) education above other content areas or instructional techniques (Stubbs & Myers, 2015; Wang & Knobloch, 2020). Various instructional approaches are possible through the natural combination of STEM and AFNR education, including those in non-formal learning, which encompasses intentional out-of-school education (Manolescu et al., 2018; Sefton-Green, 2012; Stubbs & Myers, 2015). A southeastern university held a three-week interdisciplinary, non-formal digital agriculture summer camp for high school students with three content areas: (a) precision agriculture (PA), (b) drone technology, and (c) data science. The purpose of this study was to investigate if high school students' knowledge and postsecondary interests were impacted by participating in a non-formal digital agriculture summer camp. This study was funded by USDA-NIFA award # 2021-67037-35972 and relates to the AAAE Research Value of creating STEM content connections within AFNR (AAAE, 2023).

Theoretical Framework

This study is grounded in Kolb's Experiential Learning Theory (ELT). In ELT, the learner moves through the cycle beginning with the Concrete Experience, where they are actively engaged (Kolb, 2014); for campers, this includes building drones, gathering data from crop measures, and viewing digital agriculture in animal production. The learner then moves to Reflective Observation and interpretation, where they may still build on their experience (Kolb, 2014); for campers, this includes morning reflections and group sharing. In the third stage, Abstract Conceptualization, the learner makes sense of the information, interprets their experience, and grasps ideas (Kolb, 2014); for campers, this includes flying the drones and inputting the crop data. In the stage of Active Experimentation, the learners apply their knowledge and transform their ideas (Kolb, 2014); for campers, this was problem-solving an agriculture issue and presenting it in our camp closing ceremony. The research questions were:

1. How does participating in a digital agriculture summer camp impact camper knowledge of precision agriculture, drone technology, and data science?
2. How does participating in a digital agriculture summer camp impact camper interest in AFNR, aerospace, and data science postsecondary pursuits?
3. How do camp sessions differ in terms of enhancing camper knowledge and postsecondary interest in precision agriculture, drone technology, and data science?

Methodology

The population for this study was high school students who participated in a three-week summer camp focused on digital agriculture. As the camp occurred for two consecutive summers, there were two cohorts of campers. A convenience sampling approach was used, where participants were selected based on their accessibility rather than random selection methods. In Cohort 1 ($N = 11$), there were nine male participants and two female participants, five sophomores, one junior, and five seniors. In Cohort 2 ($N = 16$), there were ten male participants and six female participants comprised of one freshman, four sophomores, five juniors, and six seniors.

This study used a researcher-designed retrospective pretest strategy; where the pretest is given simultaneously with the posttest, and participants are asked to recall their prior knowledge before experiencing a program (Allen & Nimon, 2007). At the conclusion of camp, participants were asked to complete the survey, which used a five-point Likert scale. The survey was divided into two sections, knowledge and post-secondary interest, with subsections for precision

agriculture, drone technology, and data science. The knowledge section inquired how much campers knew about the subjects before and after attending the camp. The response options were: 1 = Very Little, 2 = Little, 3 = Some, 4 = Much, 5 = Very Much. The post-secondary interest section asked campers to indicate their level of agreement to subject-specific statements. The response options were: 1 = Strongly Disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree, 5 = Strongly Agree.

Results

RQ1: Researchers conducted paired sample *t*-tests to examine the differences between pre- and post-participation camper knowledge. Precision agriculture (PA) knowledge increased $t\ (26) = 14.610$, $\alpha = .05$, $p < 0$. Aerospace knowledge increased, $t\ (26) = 21.649$, $\alpha = .05$, $p < 0$. Data science knowledge increased, $t\ (26) = 13.975$, $\alpha = .05$, $p < 0$.

RQ2: Researchers conducted paired samples *t*-tests to examine the differences in campers' post-secondary interests pre- and post-participation. PA interests increased, $t\ (26) = 4.528$, $\alpha = .05$, $p < 0$. Aerospace interests increased, $t\ (26) = 3.438$, $\alpha = .05$, $p < 0.001$. Data science interests increased, $t\ (26) = 5.409$, $\alpha = .05$, $p < 0$.

RQ3: Researchers conducted an independent samples *t*-test to compare post-participation knowledge of all areas of focus. PA indicated no difference between the two groups ($t\ (25) = .633$, $p = .27$), Year 1 ($N = 11$, $M = 3.39$, $SD = .82$) and Year 2 ($N = 16$, $M = 3.56$, $SD = .43$). Aerospace indicated no difference between the two groups ($t\ (25) = -0.037$, $p = .49$), Year 1 ($N = 11$, $M = 4.14$, $SD = .56$) and Year 2 ($N = 16$, $M = 4.15$, $SD = .54$). Data science indicated there was a difference between the two groups ($t\ (25) = 3.37$, $p = 0.00122$), Year 1 ($N = 11$, $M = 2.89$, $SD = .55$) and Year 2 ($N = 16$, $M = 3.84$, $SD = .81$).

Conclusions

The results of the *t*-tests revealed an increase in camper knowledge and post-secondary interests after participating in the digital agriculture summer camp. In Year 1, there was an increase in camper knowledge (80% in PA, 128% in aerospace, and 96% in data science). In Year 2, there was an increase in camper knowledge (70% in PA, 115% in aerospace, and 47% in data science). In Year 1, camper post-secondary interest increased (9% in PA, 16% in aerospace, and 11% in data science). In Year 2, camper post-secondary interest increased (24% in PA, 23% in aerospace, and 34% in data science).

In our comparison of enhanced knowledge between Year 1 and 2 camp groups, PA and aerospace both revealed there was no significant difference in enhanced knowledge between the two groups. For data science, there was a significant difference of enhanced knowledge about data science between the two groups. We assume this is due to Year 2 campers' prior knowledge.

Implications and Recommendations

The study findings support the value of participation in non-formal learning camps for enhancing knowledge and post-secondary interests. Short-term educational camps and non-formal learning opportunities can have positive impacts on students and benefit their learning achievements (Foster & Shiel-Rolle, 2011; Romi & Schmida, 2009). Future research should investigate differences based on gender and grade level. Also, this study showed an increase in student post-secondary interest, a follow-up study should investigate how students explain their increased post-secondary interest and how students recall their experiences.

References

Allen, J. M., & Nimon, K. (2007). Retrospective pretest: A practical technique for professional development evaluation. *Journal of Industrial Teacher Education*, *44*(3), 27–42. https://www.academia.edu/download/73953177/EJ830483.pdf

American Association for Agriculture Education (AAAE). (2023). *AAAE Research Values*.

Boone Jr., H. N., & Boone, D. A. (2012). Analyzing Likert data. *Journal of Extension*, *50*(2). https://doi.org/10.34068/joe.50.02.48

Kolb, D. A. (2014). *Experiential learning: Experience as the source of learning and development* (2nd ed.). Upper Saddle River, New Jersey: Pearson Education LTD.

Manolescu T., Florea, N., & Arustei, C. (2018). Forms of learning within higher education. Blending formal, informal and non-formal. *Cross-Cultural Management Journal*, *20*(1), 7–15. https://seaopenresearch.eu/Journals/articles/CMJ2018_I1_1.pdf

Romi, S. & Schmida, M. (2009) Non-formal education: a major educational force in the postmodern era, *Cambridge Journal of Education*, *39*(2), 257-273, DOI: 10.1080/03057640902904472

Sefton-Green, J. (2012). *Learning at not-school: A review of study, theory, and advocacy for education in non-formal settings*. The MIT Press. http://library.oapen.org/handle/20.500.12657/26062

Stubbs, E. A., & Myers, B. E. (2015). Multiple case study of STEM in school-based agricultural education. *Journal of Agricultural Education*, *56*(2), 188-204. https://doi.org/10.5032/jae.2015.02188

Tichenor, M., & Plavchan, J. (2010). Summer camps: a fun way to reinforce math skills. *Journal of Instructional Psychology*, *37*(1). https://link.gale.com/apps/doc/A224405381/AONE?u=tel_middleten&sid=googleScholar&xid=91be730a

van Delden, S., & Yang, K. P. (2014). Robotics summer camps as a recruiting tool: A case study. *Journal of Computing Sciences in Colleges*, *29*(5), 14-22. https://dl.acm.org/doi/abs/10.5555/2600623.2600626

Wang, H. and Knobloch, N. (2020). Preservice educators' beliefs and practices of teaching STEM through agriculture, food, and natural resources. *Journal of Agricultural Education*, *61*(2), 57-76. https://doi.org/10.5032/jae.2020.02057

Wang, H., & Knobloch, N. A. (2018). Levels of stem integration through agriculture, food, and natural resources. *Journal of Agricultural Education*, *59*(3), 258-277 https://doi.org/10.5032/jae.2018.03258