

Implementing Integrated STEM Forensic and Soil Sciences *

Lab Activities to Promote Interest in STEM Careers *

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Abstract

We implemented forensic and soil science integrated STEM lab activities with 11 middle school youth at a 4-H day camp at Purdue University. STEM perceived knowledge increased overall for participants. However, the pre- and post assessments did not show a statistically significant difference. More students also indicated STEM career interest after participating. Because this study was exploratory and had a small sample size, more research on these integrated STEM lab activities should be conducted with larger samples.

Introduction

STEM and forensic science education play crucial roles in the K-12 education system. STEM education encourages critical thinking, problem-solving, and analytical skills that better equip student with the ability to approach complex challenges (Nguyen et. al, 2020). Forensic science education fosters an interdisciplinary approach that combines scientific knowledge with investigative skills (Cassella & Carole McCartney, 2011). It promotes logical reasoning, attention to detail, and the ability to analyze evidence which cultivates a sense of curiosity and a desire for exploration (Azman et. al. 2021). STEM subjects contribute to developing a diverse and inclusive workforce, preparing students for careers in cutting-edge industries and emerging fields.

Soil and Forensic Sciences STEM Day Camp

We organized a Soil and Forensic Sciences STEM Day Camp in partnership with the Tippecanoe County 4-H youth development program. Eleven middle school-aged participated in the program. Youth participated in integrated STEM lab activities related to soil and forensic sciences during the 6 hour program. Youth had the opportunity to learn from undergraduate and graduate students in Agricultural Sciences Education and Communication and Forensic Science.

Integrated STEM Unit Objectives

Lesson 1 - Grow in the Dirt: demonstrate the fraction of the earth available for food production, identify the major soil components and composition, identify the living and nonliving components of the soil, explain the importance of soil water, calculate the amount of water retained in different soil type

Integrated STEM Unit Objectives-cont.

Lesson 2 - Forensic Toxicology: define forensic toxicology is and how it can be applied to real world problems, demonstrate how chromatography can be used to separate mixtures, identify which pen an unknown ink sample came from using mathematical and visual analysis, learn about careers in forensic science

Lesson 3 - Connecting Soil Science and Forensic Science: explain how soil quality impacts crop production and food, identify sources of soil contamination, explain how soil texture impacts soil contamination, explain how soil contamination affects public health, apply evidence-based reasoning to design a solution to address pollution from a real-world case study

Methods and Analysis

We distributed a paper-pencil assessment with quantitative items assessing perceived knowledge gained and interest in STEM careers. The new survey assessment was developed for this study. It was reviewed by 3 graduate students in non-formal STEM education and a 4-H youth development educator, which helped establish face validity. Sixty-three percent ($n=7$) of participants indicated that the camp increased their interest in STEM careers. We distributed a paper-pencil, quantitative pre- and post-test assessment instrument to assess youth participants' perceived knowledge gained in the soil and forensic sciences and interest in STEM careers. Data was analyzed using SPSS 28 software. Participants' perceived knowledge increased overall on a 5-point Likert scale). However, change in knowledge was not statistically significant ($p=.099$).

Results

Table 1. Perceived Knowledge Pre-Post Test Means and Standard Deviations*

	Pre M	Pre SD	Post M	Post SD
I can define soil science.	2.90	1.286	3.18	1.167
I know the percentage of earth's surface used for food production.	2.45	1.293	3.90	1.044
I can identify the main components of soil.	2.45	1.035	3.90	1.136
I can explain the composition of each main soil component.	2.72	1.272	3.18	1.078
I can explain how different soil types retain water.	2.81	1.328	3.63	1.206
I can define forensic science.	2.36	1.206	3.09	1.221
I can identify when forensic toxicology is being applied.	2.45	1.128	3.54	1.035
I can interpret the results of a forensic experiment.	2.63	1.206	3.36	1.026
I can define scientific reasoning.	2.70	1.337	3.00	1.264
I can apply scientific reasoning to solve real world problems.	3.00	1.549	3.09	1.375
I can explain how soil science and forensic science are related.	2.30	1.059	2.81	1.167
I can explain how soil quality impacts food production.	2.80	1.475	3.70	1.059
I can define soil contamination.	2.50	1.178	3.54	1.128
I can identify sources of soil contamination.	2.40	1.173	3.30	1.059
I can explain how soil quality impacts public health.	2.60	1.429	2.90	1.044
Overall	2.30	.940	3.24	1.00

Results (con't).

Table 2. Interest in STEM Career (From Pre- and Post-Tests) &

	Pre Frequency	Pre %	Post Frequency	Post %
Yes	2	40	7	64
No	3	60	4	36
Total	5**	100	11	100

*Likert items were scaled 1 to 5, strongly disagree to strongly agree.
**Some students did not complete this item on the pre-test.

Image 1. Students completing Soil Identification Lab &



Image 2. Using an apple to demonstrate the percentage of Earth's land use

Conclusion/Implications

STEM perceived knowledge increased overall for participants. More students indicated STEM career interest after participating. Because this study was exploratory and had a small sample size, more research on these integrated STEM lab activities should be conducted with larger samples, and results should not be generalized. Teachers can use our curriculum to: apply integrated STEM curriculum and hands-on learning activities in their classrooms and introduce students to soil science and forensic science topics. If future replication results appear significant, both formal and non-formal educators may want to use these activities to promote interest in STEM careers in forensic sciences.

References

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Image 3. Instructor demonstrating forensic toxicology lab



Image 4. Students researching soil contamination solutions with instructor