Somewhere Over the Rainbow is a Custom Weather and Climate Science Curriculum for K-12 Schools, 4-H & Agricultural Education Programs

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Need for Innovation

The United States Global Change Research Program (2009) stated that citizens who understand climate and can apply their knowledge in careers and their communities are desperately needed. Rogers et al. (2013) suggested that academia should focus more on better understanding the physical and social sciences, as well as quantifying the impacts of weather, climate and water on society. Dooley and Roberts (2020) write, "there is a need for innovation in curriculum and educational practices to help prepare future leaders to address complex problems" (p. 1).

Within K-12 education, each grade level can incorporate weather and climate science-related topics in the respective curricula developed by each state (The Aspen Institute, 2020). Concerning certain topics or subjects in science, Plutzer et al. (2016) noted that "most U.S. science teachers include climate science in their courses; however, their insufficient grasp of the science may hinder effective teaching" (p. 664). Dooley and Roberts (2020) said that due to extreme weather and climate events, there is a need to educate the public about weather and climate, as well as solutions to related problems.

Project Phases

Phase one is curriculum development. A multi-modal curriculum was developed for use in formal and informal teaching settings by modifying similar lessons already available from states with coastlines. The curriculum is five lessons that can be taught synchronously in a week or over several weeks. The lessons were adapted to fit South Carolina standards, as well as NGSS. To aid in successfully teaching the lessons and activities, kits were created with almost every suggested material, including a Tempest weather station and storage totes for each lesson. As an incentive for participating, educators (teachers and 4-H agents) were allowed to keep the kits at the conclusion of their pilot for their use in their programs.

Phase two is curriculum implementation. Nine pilot locations for implementing the curriculum were selected from across South Carolina. One 4-H program was pre-determined as a pilot location, then eight other places were chosen based on program uniqueness, location within South Carolina, and grade/age-level. The following locations were selected: two high school agriculture classrooms, two South Carolina Governor's School classrooms (i.e., agriculture and science), two charter middle school science classrooms, and two additional 4-H programs in varying locations throughout South Carolina.

Phase three is data collection and evaluation. Quantitative and qualitative data were collected from both student and educator participants. Student participants completed a content knowledge pre-test assessment prior to Lesson One, and educators also completed a content knowledge pre-test assessment prior to teaching any lessons. After each lesson, educators were asked to submit guided interview recordings via Zoom or another recording method, describing their experience, explaining their perceptions and confidence in teaching the materials after using the premade kit, and providing constructive feedback. Student participants completed a post-test assessment at the conclusion of Lesson Five. While the student knowledge content data is important, the educator feedback is even more important as they know what will be more useful, successful, and relevant in the classroom. Educators, classroom teachers, specifically, can speak

for lesson delivery design (i.e. too discussion-heavy or too many videos). 4-H agents are not always certified teachers, so their feedback from an informal teaching setting is also necessary to ensure the lessons are appropriate for those audiences, as well.

Results to Date

The pre- and post-tests were assigned a score value of 30 total available points. To know if each individual student gained knowledge after the lessons, a linker ID number was assigned to each student to match pre- and post-tests, and each pilot group had a custom Qualtrics link. Each group had a varying number of participants (i.e., 7 to 99) across multiple grade levels (i.e., 6–12) who participated in 4-H, FFA, or neither. Pre- and post-test scores were compared to designate an increase, decrease, or no change in knowledge. Across all groups ($N = 9$) within this pilot study, a gain in knowledge was demonstrated between the pre- and post-test assessments, ranging from a 28% increase to an 82% increase, with an average increase of 54.8%.

Educators (i.e., teachers and 4-H agents) were asked to submit recordings of their feedback about the lessons based on their experience, rating on a scale of one, very bad, to five, very good, on how the lessons and activities were, and how their students reacted to the lesson and materials. Lesson One resulted in an average rating of 4.0, with an activity rating of 4.0. Lesson Two had a lesson rating of 4.2, with an activity rating of 4.6. Lesson Three resulted in an average rating of 3.6, with the activity being ranked a 2.6. A lesson rating of 3.6 for Lesson Four was achieved with an activity rating of 4.2. Lesson Five resulted in a 4.2 with an activity score of 4.4.

Future Plans

The development of this curriculum has provided an opportunity to fill a gap where there is currently nothing like this in South Carolina. With climate change being a growing scientific concern, there will continue to be opportunities for growth and development of this curriculum in the future. Going forward, all lessons should be revamped and rewritten from scratch to be explicitly based on weather and climate science. Educator feedback described the curriculum as "sustainability or energy with a little bit about weather and climate." They expressed that some lessons are not well-connected and do not all fit South Carolina, or even weather or climate science.

The primary researcher is not a certified, formal educator and, therefore, does not have formal training in curriculum development. For the pilot project, modified lessons were used to gauge interest. Now that there is buy-in from around the state and rich, constructive feedback, new lessons should be written based on what was learned. That being said, it is recommended that a team of trained professionals in curriculum development create a more South Carolina-focused weather and climate science curriculum for future use.

Costs

The kits in the curriculum pilot are valued at approximately $1,000 each (storage totes, Tempest weather stations, activity materials, printed pages, etc.). Several of the materials can be purchased in smaller quantities based on group sizes or specific activities. Educators can seek grants or sponsors to fund their own kits, should they wish to have ready-made resources to use in their teaching.

References

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