

Rigor, Relevance, and Relationships in Coastal Louisiana Resilience Education

Summative Evaluation

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Executive Summary

Rigor, Relevance, and Relationships in Coastal Louisiana Resilience Education served high school students and their environmental science teachers in Terrebonne Parish and Lafourche Parish, Louisiana, in order to increase awareness, knowledge, and understanding of the risks due to hurricanes, sea level rise, climate change, and strategies to increase resilience locally.

The project produced a four-week curriculum unit called *Hurricane Resilience* which helps high school students learn about hurricanes, their impacts, how risks are evolving due to climate change, and strategies to increase resilience. The curriculum was designed to help students assess what parts of their communities are more vulnerable and less resilient, foster conversation about values and viewpoints in relation to resilience, and consider actions that could help local communities increase resilience in the short- and long-term.

Elements of the pilot test of the curriculum were evaluated with a survey and focus groups during the 2019-2020 school year before the pandemic caused school closures. A more finalized version of the curriculum, implemented during the 2020-2021 school year with approximately 600 students in Terrebonne and Lafourche Parishes, was evaluated with a pre-post student survey and a teacher survey. After final revision, the curriculum was implemented in the same school districts during the 2021-2022 school year with all environmental science courses - including approximately 1000 students. Both school districts plan to continue to use the curriculum with all environmental science courses in future years. Key findings and recommendations from the evaluation are summarized below.

Key findings:

- **Science knowledge gains:** In every category students reported knowing more about the science topics after the curriculum. Students in regular environmental science (regular ES) courses made particularly large, positive gains in knowledge in several topic areas as compared with AP/Honors courses.
- **Students thinking about hurricanes:** 45% of all students reported thinking about hurricanes yearly. More students thought about hurricanes daily/weekly after curriculum implementation, including 6% more regular ES students and 10% AP/Honors students.
- **Student emotions:** Regular ES students felt more nervous after the curriculum, but also reported a greater sense of resiliency and empowerment. AP/Honors students were more likely to see an increase in positive emotions and a decrease in negative emotions.
- **Student perspectives on future hurricane impacts:** Most students believed that a hurricane would impact their community within the year. The percentage of all students who said that their community would be more impacted by future hurricanes increased after curriculum implementation. (Less than six months after students completed this survey, Hurricane Ida caused catastrophic damage in their community.)
- **Types of hurricane damage:** Regular ES students were more likely to say that hurricanes will damage buildings, the economy, and the natural environment. AP/Honors

students had large shifts in thinking, particularly in relation to the amount of damage hurricanes will do to the community's buildings and economy.

- **Students helping with hurricane planning and preparation:** Although most students did believe they could help their families prepare for a hurricane before the curriculum, more students believed they could do something to help their family prepare once they completed the curriculum.
- **Feelings of empowerment:** There were large, positive shifts in all students (6-18%), but particularly among AP/Honors students (10-18%) in relation to feelings of empowerment.
- **Teachers' experience with the curriculum:** While half of the teachers had only been teaching for 1 to 2 years, the majority felt mostly or completely prepared to deliver the curriculum after the teacher professional development workshop.
- **Teachers' perspectives on the science content:** Most science content was at an appropriate level for students, according to teachers, with the exception of two topics (the connection between hurricane characteristics and damage and hurricane categories) which they felt were too easy for their students.
- **Teachers' perspectives on teaching about resilience:** While most of the teachers had never addressed resilience in an environmental science class before the *Hurricane Resilience* curriculum, 11 out of the 12 indicated that the curriculum was effective in teaching resilience. Teachers noted that in many cases it led to great discussions, promoted personal stories, was directly connected to the lives of the students and illustrated scientific concepts within the struggles their community faces daily.

Key Recommendations:

- For students in this hurricane-prone region, the *Hurricane Resilience* curriculum builds on their existing understanding, providing the largest gains in knowledge around topics such as understanding future hurricanes in a warmer climate, sea level rise and the evolving risks to communities in the future.
- Large, positive shifts in student empowerment around resilience are a positive sign that students are able to see themselves as stakeholders in the future of their community and its resilience.
- Resilience was not part of the prior environmental science curriculum, which allowed the *Hurricane Resilience* curriculum to fill an important gap. Ongoing teacher PD workshops will ensure that the curriculum continues to be successfully implemented.
- Teachers indicated that this curriculum engaged students in concepts that impact their daily lives and the future of their community. It presented "real-life" decisions, illustrating to students that these scientific concepts do not just belong in a textbook, that they can see them, and their effects, in their neighborhoods and their own families.
- Several months after the students completed their post-surveys, Hurricane Ida made landfall in this region. While we do not have a way to collect additional data on students who were part of the evaluation and their experiences and perspective about that hurricane, we do have anecdotal information from their teachers. About a month after the hurricane, when schools reopened, they wanted to teach *Hurricane Resilience* because it was relevant to students and their community's situation.

Project Overview

This project served high school students and their environmental science teachers in Terrebonne and Lafourche Parishes, Louisiana, in order to increase awareness, knowledge, and understanding of hurricanes, sea level rise, climate change, the risks that local communities face due to these challenges, and strategies to increase resilience.

The project produced a four-week curriculum unit called *Hurricane Resilience* which helps students learn about hurricanes, their impacts, and how risks are changing due to climate change and its effect on hurricanes and sea level rise. The curriculum was designed to help students assess what parts of their communities are more vulnerable and less resilient, foster conversation about values and viewpoints in relation to resilience, and consider actions that could help the community and their households increase resilience in the short- and long-term.

Within the curriculum, NOAA assets including NOAA Digital Coast and mapped hurricane data are utilized by students as they learn about the impacts that hurricanes have had on their coastal area and the projected impacts that hurricanes, strengthened by climate warming, and sea level rise will have in the future. Elements of the NOAA Climate Resilience Toolkit were embedded within lessons of the *Hurricane Resilience* unit.

While it was our original intention to have students develop resilience projects to be shared with a larger student population at a Wetlands Youth Summit and with their local community through an exhibit, the Covid-19 pandemic necessitated a change of plan as events were canceled for safety reasons. The curriculum was reformatted to focus on classroom learning - either in-person, virtual, or hybrid - and disseminated more broadly. Virtual teacher professional development workshops and broad-scale adoption of the curriculum by both Terrebonne and Lafourche Parishes allowed us to expand to reach nearly 600 students during the 2020-2021 school year and over 1000 students during the 2021-2022 school year.

We were interested to know whether the *Hurricane Resilience* curriculum increased student understanding of (1) hurricanes, climate change, and sea level rise, (2) the risks that communities face in the Louisiana Bayou, and (3) how resilience planning can help. We also hoped that the curriculum increased community engagement by helping students to see themselves as stakeholders in the future of their community and its resilience while being able to contribute to their community's resilience planning.

Evaluation methods

Pilot testing

Pre-Survey (August 2019)

During the first year of evaluation, data was collected from 52 students in three environmental science courses at South Terrebonne High School (Houma, LA) between August 14-20, 2019. A post-survey was not possible as schools in this area were closed due to the pandemic without virtual course options for environmental science courses. The evaluation results, although incomplete, were useful for revising the curriculum.

Student Focus Groups (February 2020)

Trainer Evaluation conducted three focus groups with AP Environmental Science classes at South Terrebonne High School. The students, between 5 and 7 for each group, were selected by the teacher, Ms. Adams. The focus groups ran between 26 and 34 minutes and were conducted during a class period. Trainer Evaluation also conducted an interview with Ms. Adams.

The student discussions focused on what they liked about the curriculum from the Fall, whether they felt prepared for their interviews, what they learned from both the curriculum and interviews, and what they would like to see changed for future students. The questions were largely the same for Ms. Adams, but from her perspective as a teacher. In addition to the 18 students who participated in a focus group, 10 students completed a written survey with several prompts.

Curriculum implementation

Pre-Post Surveys (2021)

During the following school year, the curriculum unit was implemented broadly throughout Terrebonne Parish, LA and one school in neighboring Lafourche Parish, LA. A pre-post survey methodology was used to measure knowledge gain and attitude/behaviors in relation to hurricanes.

The pre- and post-surveys contained the same questions as a way to understand and gauge student progression and attitude change over the course of the project (see appendix 1). The online survey included questions and rating scales related to students' awareness of hurricanes, hurricane scales, how hurricanes affect human systems and their confidence level in relation to interviewing skills. The survey also included open-ended questions allowing students to share what they know about how storms have affected their community with a rating scale indicating the degree to which this was new knowledge.

Teachers were asked to administer a pre-survey Google form to students in class between January 14-29, 2021. Due to COVID mandated moves to remote learning for some classes, delays in students receiving Chromebooks, and individual teacher and student quarantining, the window for students completing the survey was extended to February 10th. 487 responses were recorded by February 4th, with an additional 6 responses coming in by February 10th.

At the end of the *Hurricane Resilience* unit, teachers administered a post-survey Google form to students with the same questions as the pre-survey form to allow for a pre-post review of knowledge gain and attitude shift. Each teacher was contacted individually, as they each finished the unit at different times throughout March and early April. The first post-surveys from students were recorded on March 5th and the final surveys on April 2, 2021.

Sample size

- A total of 493 PRE survey responses were recorded including 396 students in regular environmental science courses and 97 students in AP/Honors environmental science courses. A sample size of 493 responses represents 82% of students receiving the *Hurricane Resilience* curriculum.
- A total of 513 POST survey responses were recorded including 416 students in regular environmental science courses and 97 students in AP/Honors environmental science courses. A sample size of 513 responses represents 88% of students receiving the *Hurricane Resilience* curriculum

Teacher Surveys (2021)

All 12 teachers (8 regular environmental science teachers and 4 AP/Honors environmental science teachers) completed an online survey at the end of the project. The survey asked about their level of preparedness to teach the curriculum after the virtual teacher professional development workshops, ease of access to online curriculum materials, appropriate level of presented materials for their students (too easy, just right, too hard), which units they found to be the most successful, the least successful and why, any modifications they made to the curriculum and why, their reflections on addressing resiliency in the science curriculum and with their students, and tips they would share with future teachers.

Findings

Findings from the pilot test

The evaluation during pilot testing (2019-2020) revealed that the format of a year-long student project was not a good fit with other curriculum and classroom activities that environmental

science teachers in the district need to cover. Logistically, fitting project activities in-between other curriculum was challenging, and student attention was divided by competing priorities. Based on this finding, we reformatted the long-term student project into a month-long curriculum unit that could be implemented in both AP/Honors environmental science and the regular environmental science courses.

Findings from curriculum implementation

Hurricane Knowledge:

In every category students reported knowing more about the topic. Regular ES students, in particular, made large, positive gains in knowledge in several topic areas.

Category	% from Pre-Survey to Post-Survey
Hurricanes	2%
Hurricane categories	5%
How hurricanes affect the natural environment	7%
How hurricanes affect communities	8%
Hurricanes that affected my community in the past	12%
How climate change affects hurricanes	13%
Sea level rise	13%
How to identify vulnerable areas in the community	16%
Connection between hurricane characteristics and damage	17%
Hurricane modeling	23%

Percentage	Category
After the Hurricane Resilience was delivered, 90-98% of students reported knowing a lot about...	Connection between hurricane characteristics and damage
	How hurricanes affect communities
	How hurricanes affect the natural environment
	Hurricanes
	Hurricane categories
After the Hurricane Resilience was delivered, 80-89% of students reported knowing a lot about...	Hurricanes that affected my community in the past
	How climate change affects hurricanes
After the Hurricane Resilience was delivered, 70-79% of students reported knowing a lot about...	How to identify vulnerable areas in the community
	Hurricane modeling

Thinking About Hurricanes:

45% of all students reported thinking about hurricanes yearly. The percentage of regular ES students who thought about hurricanes daily/weekly rose 6% after curriculum implementation. The percentage of AP/Honors students who thought about hurricanes daily/weekly rose 10% after curriculum implementation.

Regular ES students felt more nervous after the curriculum, but they also reported a greater sense of resiliency and empowerment. AP/Honors students were more likely to see an increase in positive emotions and a decrease in negative emotions after the curriculum.

Impact of Hurricanes:

Overall awareness that their family had been impacted by a hurricane in the past increased slightly in regular ES students and in AP/Honors students. However, 21% of students were still uncertain about how hurricanes had affected their family after curriculum implementation.

Damage to house/property remained the most often cited impact of hurricanes, followed by flooding. After the curriculum, regular ES students were more likely to say flooding, damage to the natural environment, and don't know in response to how their community has been affected by past hurricanes. AP/Honors students were more likely to respond 'don't know' and 'economic setback/lost jobs'. The percentage of 'don't know' increased after the curriculum in both groups of students. This is largely due to a change in coding which was based on a more rigorous coding system post curriculum. In the post-survey, answers that simply stated "damage" and "houses" with no other explanation were not counted towards damage to home/property, as they were deemed too vague to be a true answer to the question.

Most students believe that a hurricane will impact their community within the year (sadly, this turned out to be true with the arrival of Hurricane Ida). There was a drop from 23% to 11% of students who believe a hurricane will affect their community in the next five years, and an increase from 8% to 20% of students who believe a hurricane will affect their community in the next ten years.

In every case, the percentage of all students who said that an area of the community would be more impacted increased. Students believe that the buildings, the economy, and the natural environment of their community will be impacted at a greater rate than they did before the curriculum (again, sadly, this turned out to be true).

Regular ES students were more likely to say that hurricanes will damage buildings, the economy and the natural environment. They are now less likely to think that hurricanes will cause damage to the people in their community. AP/Honors students had large shifts in thinking, particularly in relation to the amount of damage hurricanes will do to the community's buildings and economy.

Preparedness:

Although most students did believe they could help their families prepare for a hurricane before the curriculum, more regular ES students and AP/Honors students believed they could do something to help their family prepare after the curriculum.

Buying supplies, boarding windows, laying sandbags and cleaning/tying down loose items were the most oft cited ways students mentioned they could help their family prepare for a hurricane.

After the curriculum, regular ES students were more likely to say that they could have a plan, buy/gather supplies, and lay sandbags to help their family prepare. AP/Honors students essentially flipped their thinking from helping their family by buying/gathering supplies to boarding windows. They were also more likely to say that they can help their family by having a plan and tying down loose items/cleaning the yard.

Empowerment & Resilience:

There were large, positive shifts in all students (6-18%), but particularly among AP/Honors students (10-18%) in relation to feelings of empowerment.

The percentage of “don’t know” increased for both regular ES students and AP/Honors students after the curriculum. One reason is that during coding, answers such as “damage” and “flood” with no other explanation were grouped with “don’t know”, as they were deemed too vague to be a true answer to the question in the post-survey. One of the biggest changes was the number of students who chose not to answer this question - perhaps because it was the last question in the survey, or because it was the week before Spring Break; we can’t know.

Teacher Survey

Half of the teachers involved in this project had only been teaching for 1 to 2 years, and just over half of the teachers had only been teaching environmental science for 1 to 2 years. However, after the teacher professional development workshop, the majority of teachers felt mostly, or completely, prepared to deliver the curriculum. Teachers had an easy time accessing the materials online and said that the materials were well organized. Teachers also largely found the curriculum to be appropriate for their students with two exceptions; they believed the topics of the connection between hurricane characteristics and damage and hurricane categories to be too easy for their students.

Lesson 8: Modeling Hurricane Impacts was generally viewed to be the most successful lesson because it was hands-on, was designed to increase the level of engagement from students, included “real-life” decisions, was well planned, and included attractive visuals.

Lesson 3: Storm Stories was the least successful largely because it required students to do interviews and do work outside of class, two things they did not enjoy.

75% of teachers made modifications to the curriculum. Some shortened parts or combined others to keep themselves on track. Others spent a bit longer in some sections based on the needs of their class. Some teachers added components, again, based on the needs of their students, such as analysis questions, a slide show, annotated reading, and assessments.

Most of these teachers had never addressed resilience in an environmental science class before the *Hurricane Resilience* curriculum. After teaching the curriculum, 11 out of the 12 teachers indicated that the curriculum was effective in teaching resilience. Teachers reported that in many cases the curriculum led to “great discussions”, promoted personal stories, was directly connected to the lives of the students and illustrated scientific concepts using the struggles their community faces daily.

Conclusions and Recommendations

While students in the Louisiana Bayou live with hurricane risks, and their general understanding of hurricanes was relatively high, students had the largest learning gains around understanding future hurricanes, climate change, sea level rise and the evolving risks to communities in a warmer climate. Thus, the curriculum builds on their existing knowledge. Large, positive shifts in student empowerment around resilience are a positive sign that students are able to see themselves as stakeholders in the future of their community and its resilience.

Resilience was not part of the environmental science curriculum prior to *Hurricane Resilience* and 92% of the teachers in this project had never addressed resilience in their environmental science curriculum before this project. This left a huge gap in the understanding of both teachers and students in the district. Importantly, teachers indicated the importance of this curriculum as it engaged their students in concepts that impact their daily lives and the future of their community. It presented “real-life” decisions, again, illustrating to students that these scientific concepts do not just belong in a textbook, that they can see them, and their effects, in their neighborhoods and their own families. Perhaps because of this immediacy, several teachers reported having “great conversations” with their students during the curriculum.

Several months after the students completed their post-surveys, and while the next school year had started, Hurricane Ida made landfall in this region. While we do not have a way to collect additional data on students who were part of the evaluation and their experiences and perspective about that hurricane, we do have anecdotal information from their teachers. About a month after the hurricane, when schools reopened, teachers wanted to teach *Hurricane Resilience* as it was relevant to students and their community’s situation.

Due to teacher turnover, ongoing teacher PD workshops will be needed to ensure that the curriculum continues to be successfully implemented in this region. The South Louisiana Wetlands Discovery Center plans to provide teacher PD in the future.