

PREFER Social Impact Report

Reporting Period: September 1, 2020 – February 28, 2024

Evaluator: Heather N. Stone

I. INTRODUCTION

The study aimed to identify, analyze, assess, and monitor the potential social impact of PREFER: Precise Regional Forecasting via Intelligent and Rapid Harnessing of National Scale Hydrometeorological Big Data [1, 2]. Our outreach focused on understanding how this technology could potentially impact middle school students, providing them with ‘real-world’ examples like weather predictions to reflect on and understand their agency and social issues. The partnership with a local school to teach about the applications in PREFER to middle school students illustrates the importance of reaching out to students to prepare them for global citizenship.

In order to develop and implement a social impact initiative that had the possibility to create systemic change, the PREFER Social Impact Study team, which was led by Dr. Heather N. Stone and involved two project investigators (Dr. Nian-Feng Tzeng and Dr. Li Chen) plus two funded GRAs (Bryce Turney and Sanjeev Panta), decided to look at how the PREFER project could help middle school students understand a social challenge that their communities might face now or in the future. We then decided on a plan of what information/data from the PREFER project would support the objectives of sharing authentic knowledge. We were able to partner with a middle school teacher who was willing to share his instructional time, and we planned to visit the classroom when he was teaching about the weather so that we could enhance his current curriculum.

To understand the social impact that PREFER might have on middle school students, three goals were chosen from the 17 Social Development Goals (SDGs) set by the United Nations. The SDGs are a way for individuals, businesses, and organizations to work toward making a significant impact in the world (The SDGs explained).

Three SDGs which aligned with the PREFER Social Impact Study, are as follows:



Goal 4

Quality Education

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.



Goal 9

Industry, Innovation, and Infrastructure

Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.



Goal 11

Sustainable Cities and Communities

Make cities and human settlements inclusive, safe, resilient, and sustainable.

The PREFER team created presentations geared towards middle school students, which were presented over two days, February 6, 2024 and February 7, 2024. Presentation materials, including Powerpoint file of slides and two video clips respectively on “Basics of Weather Forecasts” and “PREFER Project Introduction,” can be found at https://prefer-nsf.org/publications_software.html (under Item (6) at the page). Before the in-class presentations, students and parents were asked for their assent and consent to participate in data collection as required by the Institutional Review Board.

II. PARTICIPANTS

A total of 27 students provided assent and completed both pre-and post-tests, with 10 female students, 15 male students, and 2 who did not identify their gender. Their ages ranged between 13 and 14 years old. All students were under the supervision of one eighth-grade classroom teacher.

III. METHOD

Students were measured twice, before and after the activity. Students were measured on several aspects:

- Overall knowledge of weather issues
- Perceived level of competence in weather issues
- Interest in weather issues
- Interest in social issues
- Self-efficacy (perceived ability) in social issues
- Interest in contributing to the community

Classroom Presentations: The presentations were given to four different 8th-grade classes over the course of two consecutive days.

Day One

- General Information about the weather
- Introduce students to weather devices
- Show Weather Underground and Mesonet system
 - Present a trained model to show predictions
 - Show how data is gathered
- Have students interact with Weather Underground
 - Find a station that interests them. It can be near their house or a place that they would like to know more about

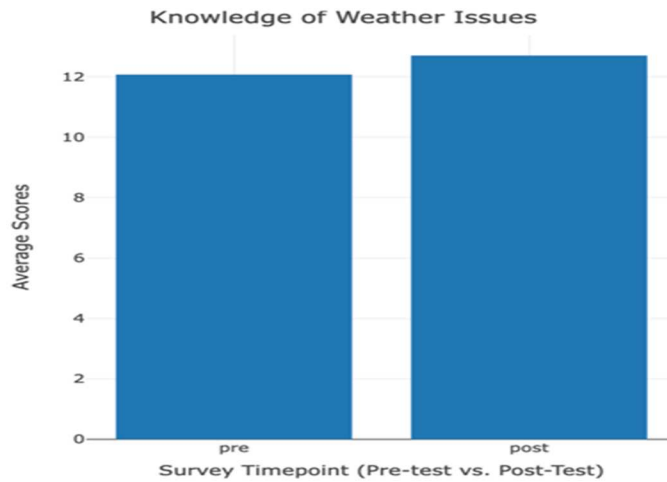
Day Two

- Explanations of weather stations and details on data that show how they can make predictions
 - Show trend models and how AI works on a high level
- Let students practice with a “black box” AI weather system to see how the predictions work

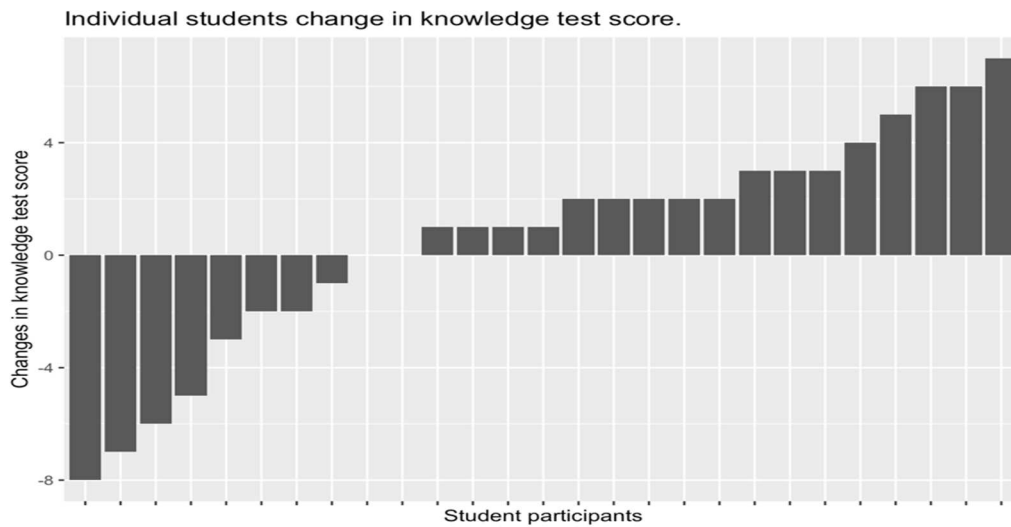
IV. RESULTS

1. Overall knowledge in weather basics and issues

Students’ knowledge on weather basics and issues was measured using 19 questions. As shown in the following figure, student’s knowledge on weather issued improved slightly from an average score of 12.07 to 12.7. This difference, tested with Wilcoxon test, was significant (for $W = 0$, $p < .001$).

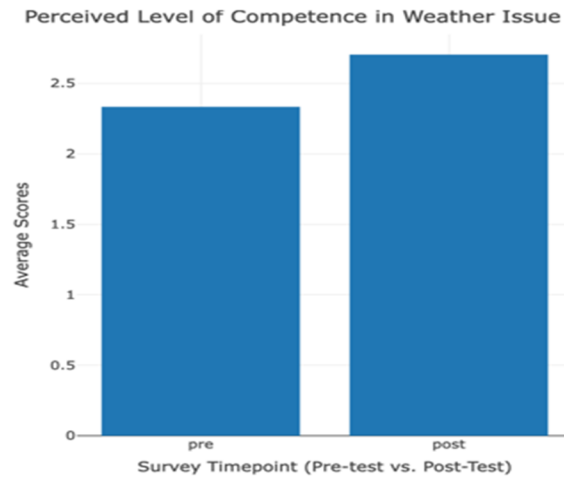


More than one half of students (i.e., 17 out of 27) showed improvement, as detailed in the following figure.



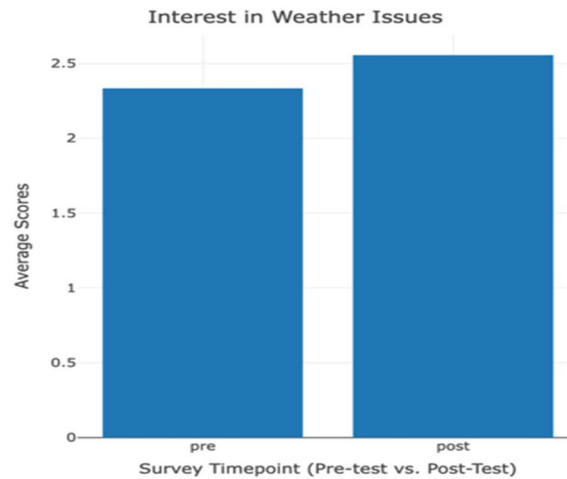
2. Perceived level of competence in weather issues

Students' perceived level of competence on weather issues was measured using one question, "My level of knowledge and weather forecasts is" using a 5-point Likert scale from 1 (nil) to 5 (extremely high). Students' perceived level of competence on weather issues improved slightly from an average score of 2.33 to 2.7, as depicted in the following figure. This difference, tested with Wilcoxon test, was significant (for $W = 58$, $p < .001$).



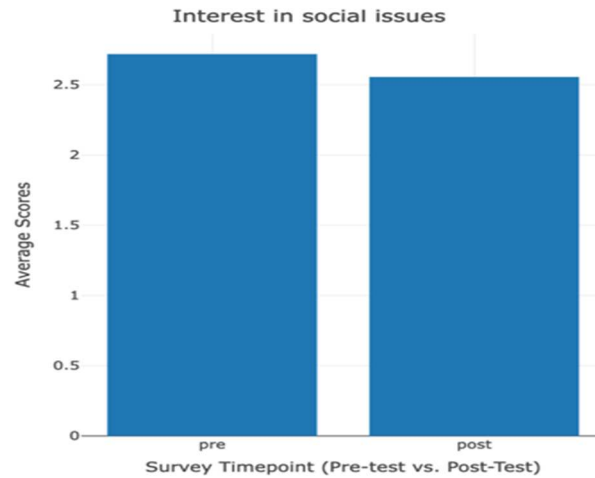
3. Interest in learning more about weather basics and issues

Students' interest in learning more about weather basics and issues was measured using one question, "My level of interest in weather is" using a 5-point Likert scale from 1 (nil) to 5 (extremely high). Students' interest in weather basics and issues improved slightly from an average score of 2.4 to 2.51, as depicted in the following figure. This difference, tested with Wilcoxon test, was significant (for $W = 105$, $p < .001$).



4. Overall interest in social issues

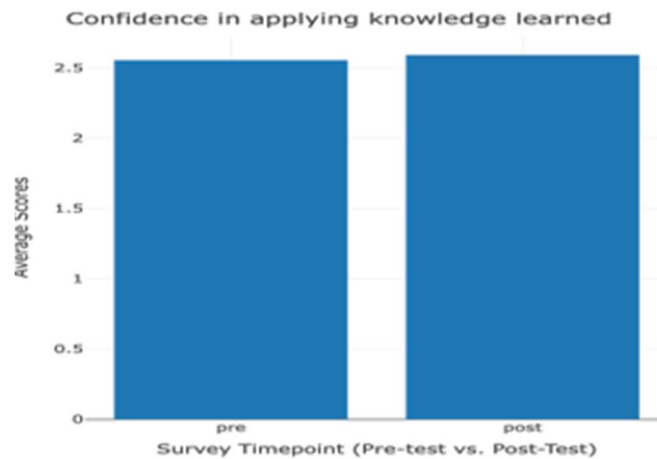
Students' interest in social issues was measured by an adapted scale of interest in Social Studies pursued by Gehlbach *et al.* in 2008 [4]. The 5-item scale was measured on a 5-point Likert scale from 1 (nil) to 5 (extremely interesting). Students' interests changed from an average score of 2.72 to 2.56, as depicted in the following figure. Individuals' changes, tested by Wilcoxon test, was significant ($W = 83.5$, $p < .001$).



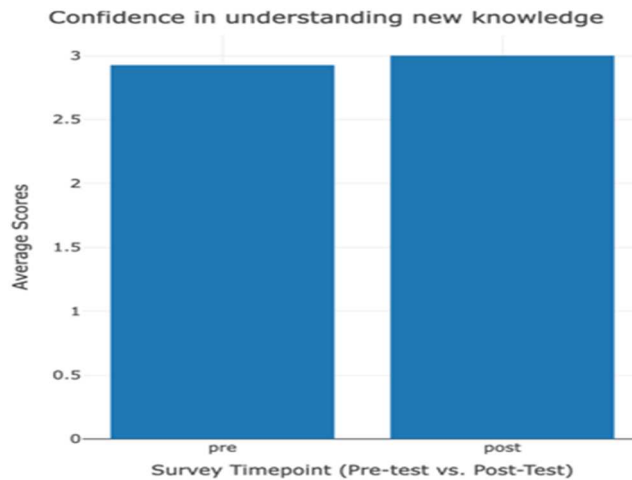
5. Self-efficacy (perceived ability) in social issues

Students' perceived efficacy in social issues was measured across different questions, as follows.

One question was "how confident are you that you can apply what you have learned to help resolve the social issues introduced in this program?", rated on a 5-point Likert scale from 1 (not at all confident) to 5 (extremely confident). Students' efficacy in social issues was about the same, from an average score of 2.56 (prior to this activity) to 2.59, as illustrated in the figure below. Individual' changes, tested using Wilcoxon Test, were significant (for $W = 92$, $p < .001$).



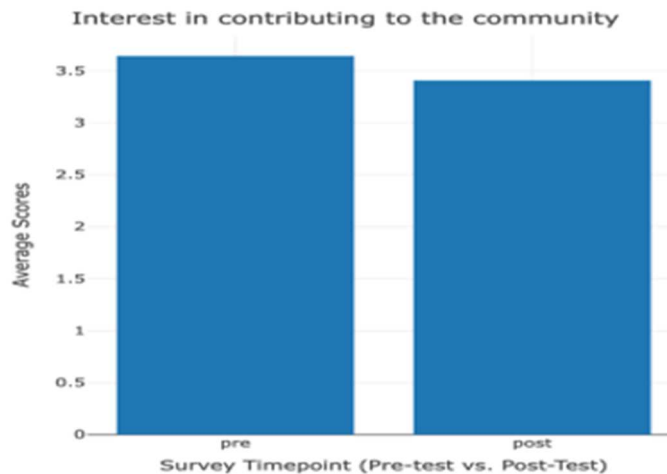
Another perceived efficacy question was "when complicated ideas about the social issues are presented in this program, how confident are you that you can understand them?", rated on a 5-point Likert scale from 1 (not at all confident) to 5 (extremely confident). Students' efficacy in social issues was about the same, from an average score of 2.93 (prior to this activity) to 3.0, as illustrated in the figure below. Individual' changes, tested using Wilcoxon Test, were significant (for $W = 14$, $p < .001$).



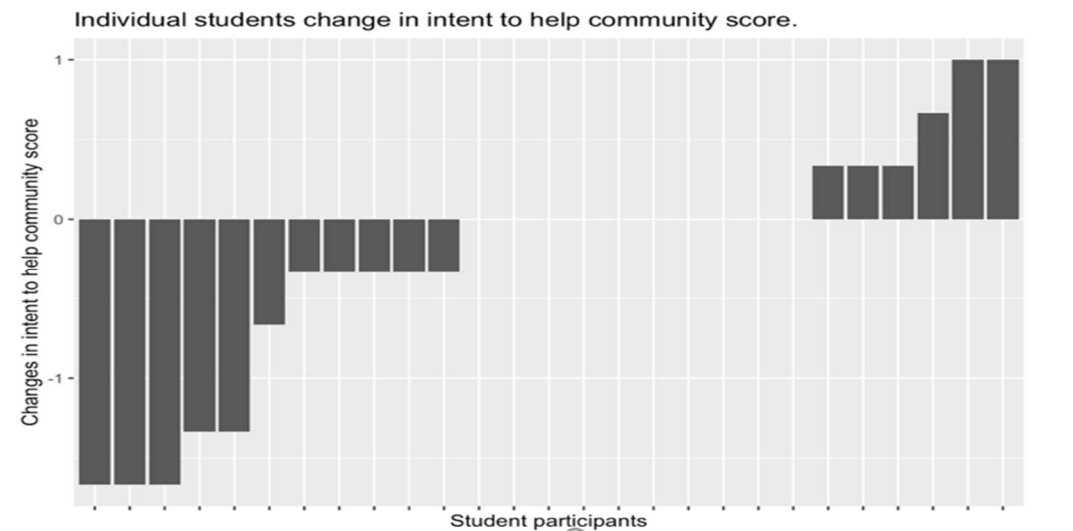
However, when asked, “How confident are you that you will remember the social issues introduced in this program next year?”, student did not report an increase in confidence of remembering the program materials, with the average for pre-activity score being 2.56 and the post-activity score being 2.48 (for $W = 75$, $p < .001$).

6. Interest in contributing to the community

Students’ interest in contributing to the community was measured by a scale adopted from the civic engagement beliefs subscale introduced by Volght and Torney-Purta [5]. Students’ interest in contributing to the community dropped, with a pre-activity average score of 3.64 and the post-activity average of 3.41, as shown in the following figure.



Examining individual students’ changes, it seems that there were four students with large drops in their intents to help, as outlined below.



V. CONCLUSION

This social impact report represents the findings of teaching middle school students about the PREFER project. Twenty-seven middle school students were given a pre-test to measure their knowledge of weather, interest in social issues, and opinions on contributing to their community. Then, after two days of instruction about PREFER, a post-test was administered. The results showed a slight improvement in overall knowledge and perceived competence about the weather. There was also a small increase in wanting to learn about the weather. In contrast, there was a decline in interest in social issues and helping their communities. This study studied a small sample of students from one classroom. It would be beneficial to repeat the study with a larger sample size across multiple classrooms to determine whether promoting the PREFER project among middle school students would result in increased social impact aligned with the Sustainable Development Goals of Quality Education, Industry, Innovation, and Infrastructure.

REFERENCES

- [1] Office of Integrative Activities (OIA), National Science Foundation, "RII Track-2 FEC: Precise Regional Forecasting via Intelligent and Rapid Harnessing of National Scale Hydrometeorological Big Data," URL – https://www.nsf.gov/awardsearch/showAward?AWD_ID=2019511.
- [2] PREFER: Precise Regional Forecasting via Intelligent and Rapid Harnessing, URL – <https://prefer-nsf.org/index.html>.
- [3] Global Goals for People and Planet, United Nations: Global Compact, *The SDGs Explained for Business: UN Global Compact*. URL – <https://unglobalcompact.org/sdgs/about>.
- [4] H. Gehlbach, S. W. Brown *et al.*, "Increasing interest in social studies: Social perspective taking and self-efficacy in stimulating simulations," *Contemporary Educational Psychology*, vol. 33 (4), pp. 894-914, October 2008. URL – <https://dash.harvard.edu/handle/1/11385610>.
- [5] A. Voight and J. Torney-Purta, "A typology of youth civic engagement in urban middle schools," *Applied Developmental Science*, vol. 17 (4), pp. 198–21, October 2013. URL – <https://doi.org/10.1080/10888691.2013.836041>.