Nuclear Weapons and Security Policy: Past and Present

Impact Study

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Key Findings

GBH Education conducted a randomized controlled trial (RCT) with nine teachers across nine states who taught over 340 students. Within teachers, some classes were randomly assigned to a treatment group who used the *Nuclear Weapons and Security Policy: Past and Present* collection (NWC) digital media materials, while other classes were assigned to be in a control group who received instruction with the teachers' usual teaching materials. We gathered data through pre- and post-intervention student surveys and teacher focus groups.

Students started the study with limited information about nuclear weapons.

- Only 15% said they had learned "a lot" about nuclear weapons and only 19% said they were "knowledgeable" on the pre-survey.
- Only 61% of students knew the approximate number of countries with nuclear weapons ("more than 2 and less than 15")

Students demonstrated significantly greater gains in knowledge of nuclear weapons and security policy.

- Students in treatment classes improved 13% on multiple-choice questions from pre- to post-intervention, compared to –1.4% in control classes.
- Open-response scores increased 36% in treatment vs. 20% in control.

Students showed larger gains on topics rarely covered in standard high school courses.

- The treatment group showed a 39% higher understanding of the risks of nuclear weapons beyond warfare (+7% for control) from pre- to post-intervention.
- The treatment group showed a 41% higher understanding of the link between the decline in nuclear testing and the Nuclear Test Ban Treaty (+5% for control).
- The treatment group showed a 29% higher knowledge of nuclear proliferation (–6% for control).

Students also gained confidence in advocating for nuclear policy change.

- The treatment group showed a 9% increase in self-efficacy, compared to 3% for control from pre- to post-intervention.

Students deepened their overall understanding of nuclear weapons.

- 84% of students in the treatment classes said the resources taught them new information about nuclear weapons, and 80% reported learning a lot about nuclear weapons.

Teacher Quotes

- "Typically, we're teaching from the forties up through the eighties with the US and the USSR, but this opened it up to China and France... it has become more widespread than just those two countries." – Teacher (Alabama)
- "There were several students that you could see as the realization of all of this being real hit them... they were interested in how other countries were creating policies." – Teacher (Kentucky)

Introduction

Although the fear of nuclear catastrophe has somewhat faded from public discourse, the issues and dangers around nuclear arsenals are no less pressing. There are currently nine countries with nuclear weapons that together possess over 12,000 nuclear warheads.[1] Increased global tensions, with wars in Eastern Europe and the Middle East as well as escalating threats in East Asia, have intensified the threat of nuclear war. In January 2025, the Bulletin of the Atomic Scientists announced that they had moved The Doomsday Clock up to 89 seconds before midnight. The Clock, their symbolic assessment of the risk of nuclear conflict and other man-made existential threats, is "the closest to global catastrophe it has ever been."

This study examines whether providing students with curricularly-aligned digital media resources that teach about nuclear weapons and history can improve students'

[1] ICAN. (2024). Which countries have nuclear weapons? International Campaign to Abolish Nuclear Weapons. https://www.icanw.org/nuclear_arsenals

understanding of nuclear weapons and broaden their perspectives on nuclear weapons policy. The *Nuclear Weapons and Security Policy* collection on PBS LearningMedia is a set of free educational resources that include short videos, both excerpts from documentaries and original videos, interactive timelines and images, and self-paced digital lessons. These resources were developed with input from expert advisors on nuclear weapons policy as well as current high school teachers. The collection has been used by over 11,000 users generating 96,000 pageviews and 140,000 minutes of engaged time on the platform.

In Spring 2025, GBH designed and implemented an impact evaluation of the *Nuclear Weapons and Security Policy* collection. The evaluation was led by the Director of Research & Evaluation and a team of educational researchers who were not directly involved in the production of the resources.

Through a mixed methods randomized controlled trial (RCT) with nine teachers and 340 student participants, we answered the following research questions:

- What was students' pre-existing knowledge about nuclear weapons prior to being exposed to the NWC resources?
- What were teachers' and students' perceptions about NWC resources and their contribution to students' understanding about nuclear weapons historically and in the present day?
- To what extent does instruction with NWC materials improve students' knowledge of nuclear weapons history and policy compared with business-as-usual instruction?

Research Design

We used a randomized controlled trial design in the study. By randomly assigning the intervention, we ensured that, on average, participants in the control and treatment groups had no pre-existing differences before the intervention. This allowed the study to accurately assess the extent to which any observed changes were a direct result of exposure to the materials in the collection.

Since the study took place in high school classrooms, we could not randomly assign individual students to different groups. Instead, we used a "cluster" randomized controlled trial, where entire classes were randomly assigned. Specifically, we used a

"within-teacher randomization" approach. This meant that within each teacher's set of classes, some were randomly assigned to use the special "treatment" materials, while others were assigned to a "control" group where the teacher used their usual Cold War unit materials. We understood that teachers being exposed to the special materials might unintentionally change how they taught their control classes, but we felt this risk was acceptable because any such "contamination" would only make the observed effects seem smaller. There were no statistically significant or practical differences between treatment groups on the pre-survey for any of the knowledge or attitudinal outcomes ($p > 0.1$), indicating the random assignment functioned as intended.

Intervention

The research intervention for the study consisted of six activities and a Youth Media Challenge (Table 1). The intervention took approximately 2–3 weeks to finish with the assumption that students spend some time working on activities outside of the classroom. Resources were selected in consultation with content experts from GBH and external advisors.

Table 1: Intervention Roadmap

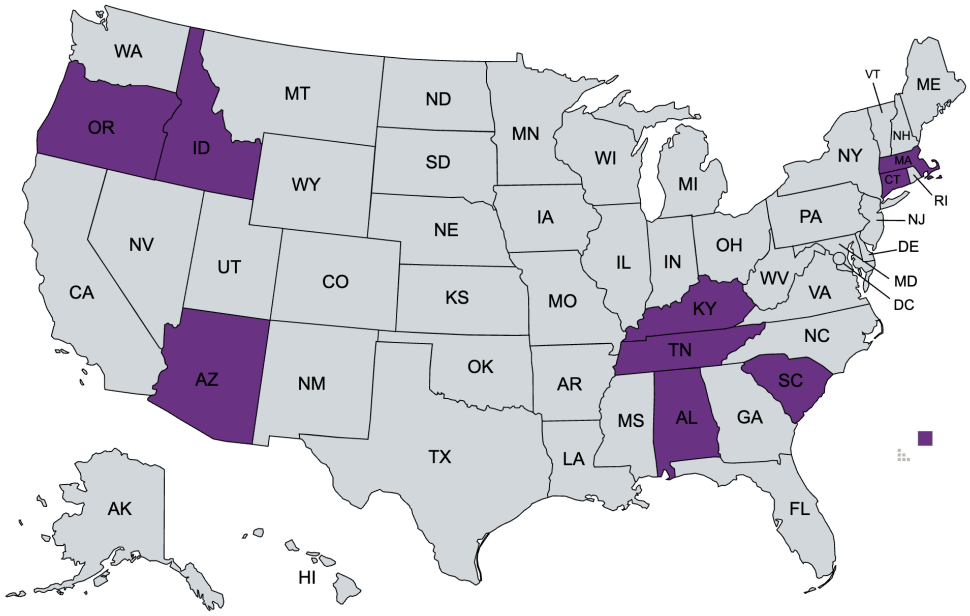
Resource	Estimated Class Periods
Background	
Nuclear Basics | Interactive Lesson	1
Nuclear Weapons and Policy: The First 75 Years | Interactive Timeline	1-2
Risks of Nuclear Weapons	
Beyond Warfare: The Risks and Consequences of Nuclear Weapons | Interactive Lesson	1-2
Nuclear Weapons Today	
The Nuclear World | Interactive Map	1
Civic Action Related to Nuclear Weapons (Choose 2)	

Resource	Estimated Class Periods
The 1964 "Ice Cream" Ad: From Nuclear Testing to Political Action	0.5-1
Music and Film in the Nuclear Age	1
Civic Leaders: Youth Voices on Nuclear Policy | Youth Stand Up	1
Youth Media Challenge	3-4
Students select one of three essential questions about nuclear weapons and security policy to address by creating either an informational video, a PSA, or a creative video (such as a video featuring an original song)	

Recruitment, Sampling, and Data Collection

Teachers were recruited through email mailing lists. Teachers were required to a) be full-time U.S.-based high school social studies teachers who taught at least two classes of the same level and type; b) be able to use selected resources in their classes; and c) teach about nuclear weapons during the study period. In selecting teachers for the study, we intentionally oversampled from rural schools and schools in the South and the West in order to ensure geographic diversity (Figure 1). In total, nine teachers and their 25 classes completed the entire study. Teachers reflected a diversity of school and professional experiences. Teachers came from nine states in all regions of the country (Figure 1). All teachers worked at district public schools.

Figure 1: States Represented in the Nuclear Weapons and Security Policy Study



In total, 343 students obtained parental consent to participate in the study and 336 completed a pre-survey. Of those students, a match for the post-survey could be obtained for 267 students. Thus, the attrition rate at the student level was 22%. Demographics for the matched student sample are presented in the following table (Table 2).

Table 2: Student Demographics (Pre-Post Only)

Race/Ethnicity	Gender	Parent Highest Education
• 62% White • 11% Latino • 10% Multiracial • 10% Black • 5% Asian • <1% Middle Eastern	• 48% Female • 52% Male	• 14% Did not finish HS • 9% Graduated HS • 14% Some post-HS • 27% College degree • 36% Graduate degree

Quantitative Data Collection and Analysis

Teachers were asked to complete weekly implementation logs. The implementation log was distributed online every Monday during the study period. For each treatment class, teachers reported which Nuclear Weapons and Security Policy resources they utilized that week (if any), what data (e.g., pre-test, post-test) they collected from students (if any), what support materials they used, and whether they encountered any challenges with the intervention or had other comments. We also asked what they taught in their control classes. The implementation log provided a means to monitor the teachers' progress, collect a measure of treatment fidelity (i.e., the extent to which teachers were following the intervention implementation protocol), and ensure that teachers' control classes were not influenced by the collection materials.

Students completed pre- and post-surveys. Both surveys contained a content knowledge measure that consisted of 9 multiple-choice and 4 open-response questions. The items were developed by the researchers in consultation with experts in nuclear weapons history and policy. As part of the development process, we conducted cognitive interviews with high school students to ensure that the questions were clear and measured the intended construct.

Open-response questions were all scored by human raters who were trained on a standardized rubric. Responses were rated on a scale of 0–2. Raters were not informed about whether the student's response was from the treatment or control groups. To

measure inter-rater reliability, 51% of the responses were scored by multiple raters. In total, 68% of scores exactly matched and 98% were within one category. The weighted Cohen Kappa was 0.60. Both the multiple-choice and open-response items were summed to calculate individual student score. These scores were then combined to create a composite across all questions. The reliability of the multiple-choice scale was slightly low (pre $\alpha = 0.47$, post $\alpha = 0.52$), but this is not usual with a relatively short measure on a topic where students do not often have a lot of prior exposure. The reliability of the open-ended scale was lower on the pre-survey (pre $\alpha = 0.47$) but improved on the post-survey (post $\alpha = 0.66$).

Attitudinal scales were modified from previously validated instruments that have been used successfully in other studies. We measured students' self-efficacy for engaging in advocacy around nuclear topics, interest in nuclear weapons history and policy, media consumption related to nuclear weapons, and plans for future participation with nuclear issues. Students responded on a 5-point Likert scale to all of the attitudinal questions and the scales were averaged into composite measures. All attitudinal scales had a sufficient level of reliability on the pre- and the post-surveys ($\alpha >= 0.85$).

We included a series of feedback questions on the treatment post-survey to assess students' perceptions of the collection resources and the impact on their learning. All questions used a 5-point Likert scale and were averaged prior to analysis.

In our analysis, we calculated descriptive statistics for all of the items and scales. We then fit a series of two-level hierarchical linear regression (HLM) models that were run on all outcome variables (knowledge and attitudinal). The following equation represents the primary model fit to data in all analyses.

$$\text{Post-Test}_{ij} = \gamma_{00} + \gamma_{01}(\text{Treatment})_j + \beta_1(\text{Pre-Test})_{ij} + u_{0j} + r_{ij}$$, where *i*=students,

j=classrooms

As a sensitivity analysis, we also tested models with teacher fixed effects and student demographics (e.g., race, gender, parent education) to determine if changing the models affected the overall effect size or statistical significance.

Qualitative Data Collection and Analysis

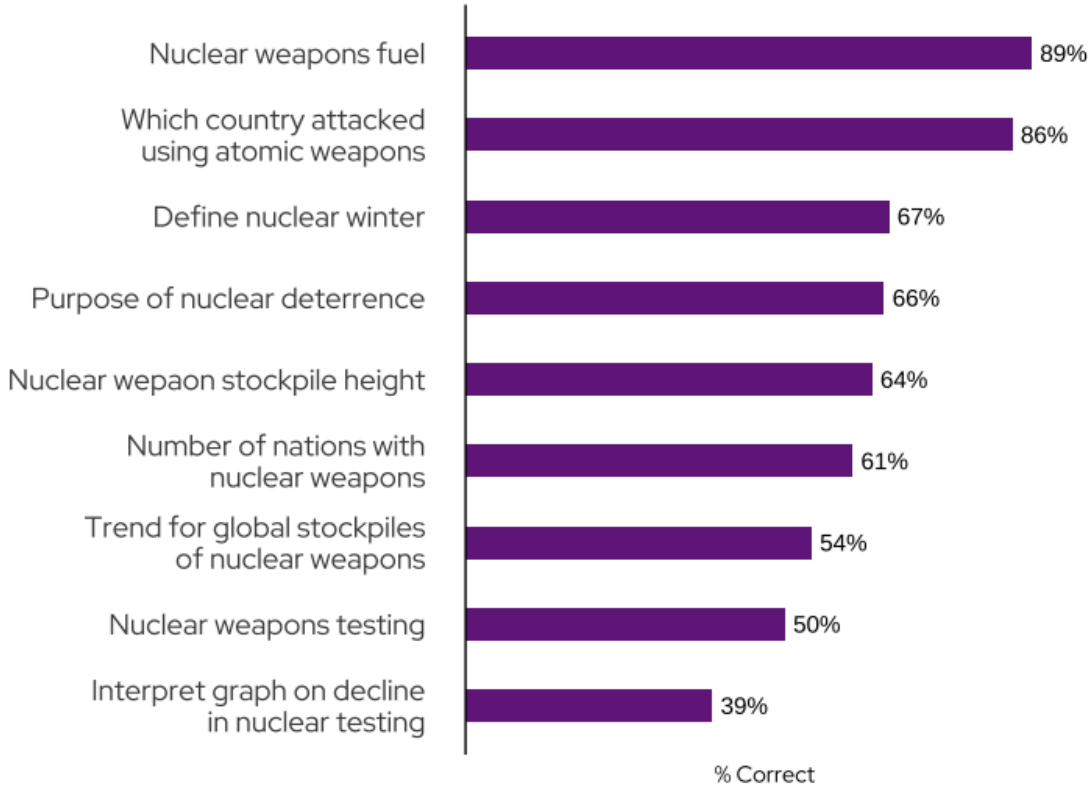
In addition to quantitative data collection and analysis, we also conducted focus groups with teachers after the intervention to gather data on teachers' perceptions and observations about instruction with the materials. Teachers were asked to provide feedback on curricular alignment, ease of use, use of support materials, and student engagement. Focus groups were recorded and auto-transcribed using the built-in Zoom transcription tool for analysis. The transcripts were then reviewed and coded for themes based on pre-existing frameworks as well as emergent themes from the data. Students' perceptions were also measured using open-response questions on the post-survey (treatment only).

Results

Students' Pre-Existing Knowledge

Students had limited knowledge of nuclear weapons history or policy. Only 15% said they had learned "a lot" about nuclear weapons and only 19% said they were "knowledgeable." Student responses on the pre-assessment indicated only knowledge of basic facts about nuclear weapons. For example, while 86% of students knew that Japan had been attacked by nuclear weapons, only 61% knew the approximate number of countries with nuclear weapons ("more than 2 and less than 15") and only 50% could correctly identify trends in nuclear weapons testing (Figure 2).

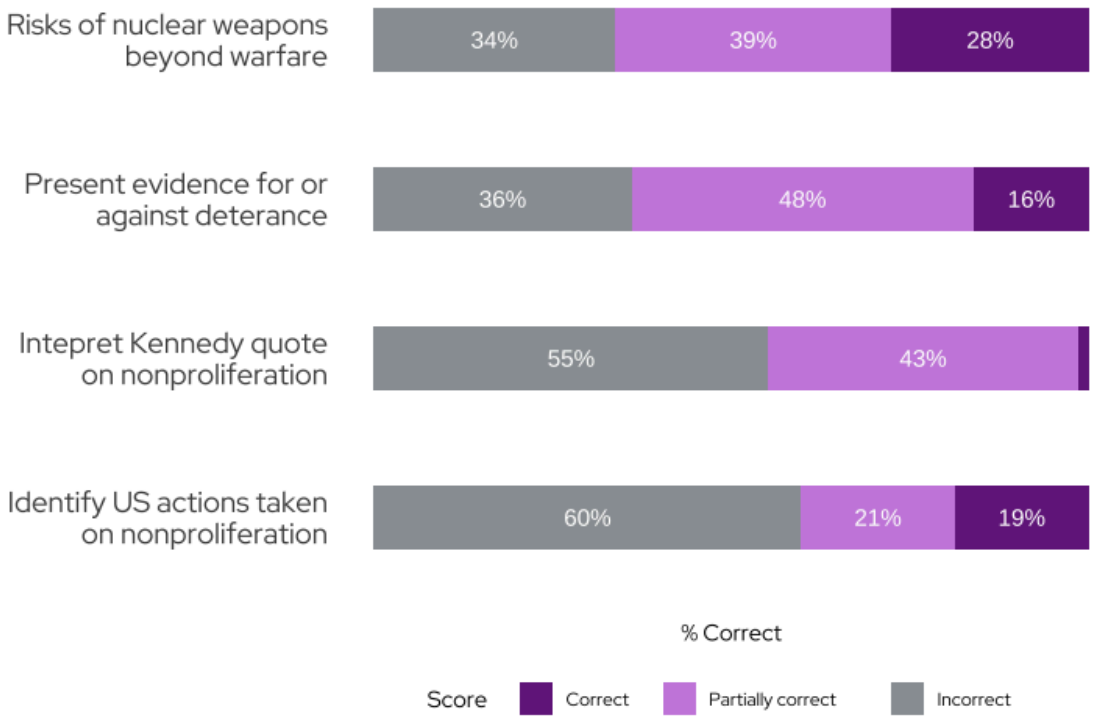
Figure 2: Student Performance on Multiple Choice Questions on Pre-Survey



Students performed even worse on the open response questions– 28% could name two effects of nuclear weapons beyond warfare, 19% could correctly identify an action the United States has taken to stop the spread of nuclear weapons, 16% could present

evidence for against deterrence, and only 2% correctly interpreted a quote from President Kennedy about nonproliferation (Figure 3).

Figure 3: Student Performance on Open Response Questions on Pre-Survey



In the focus group, teachers confirmed that most students did not have a strong understanding of nuclear weapons, noting that most of what students were exposed to was limited to the beginning of the Cold War. As one teacher observed:

> Before the curriculum my students knew almost nothing about nuclear weapons . . . they knew they were big bombs, they knew the Cold War . . . they didn't really know the ins and outs of the weapons, and they also didn't know the proliferation issue.

Students' and Teachers' Perceptions of the Collection

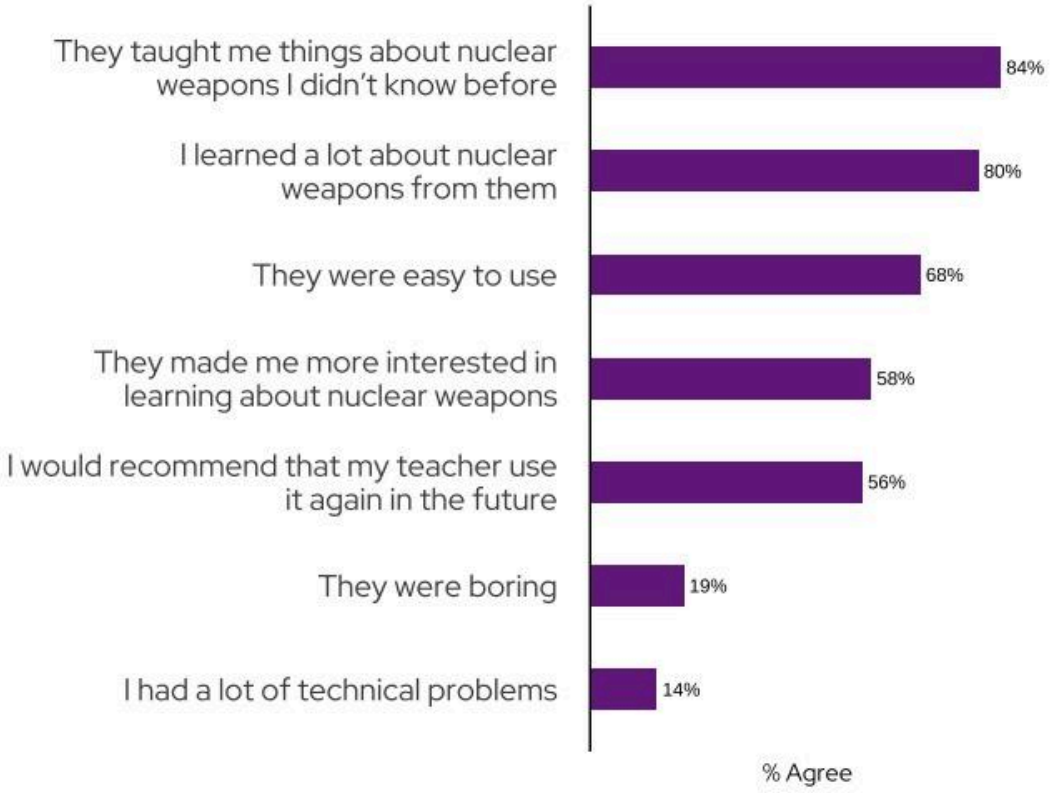
Teachers observed that the *Nuclear Weapons and Security Policy* collection resources extended beyond the typical scope of classroom instruction on nuclear weapons,

addressing specific topics that teachers noted are often overlooked. For example, teachers appreciated that the curriculum discussed the proliferation of nuclear weapons, particularly in the post-Cold War era. Teachers also valued that the curriculum discussed the science of nuclear weapons and the effects of a nuclear explosion on the environment and human health. As one teacher observed, "I usually do the history and the Cold War aspect, but learning about the weapons themselves was great and different from what I usually teach."

Both teachers and students appreciated the interactivity of the lessons. One teacher said that students liked the "drag and drop features" and how "they can engage with a little bit of the graphs or the timeline." A student commented that they liked the "interactive maps the best, because you had to interpret the information yourself." Teachers also thought that the Youth Media Challenge gave students a chance to express themselves creatively and apply skills they would not ordinarily get to use in school—"it was nice to see them flex their creative juices." Students also liked the personal stories in the collection that highlighted the experiences of people affected by nuclear weapons and people involved in nuclear advocacy.

In the post-survey, students in treatment classes largely reported positive perceptions of the collection (Figure 4). Most students (84%) said the resources taught them things they didn't know before, and 80% said they learned a lot about nuclear weapons. Many students also agreed that the materials were easy to use (68%), reflecting feedback shared in the teacher focus groups. The majority of students said the materials made them more interested in learning about nuclear weapons (58%) and they would recommend their teacher use them again in the future (56%). Only a small portion of students said they thought the materials were boring (19%) and that they had a lot of technical problems (14%).

Figure 4: Students' Overall Perceptions of the *Nuclear Weapons and Security Policy* Resources[2]

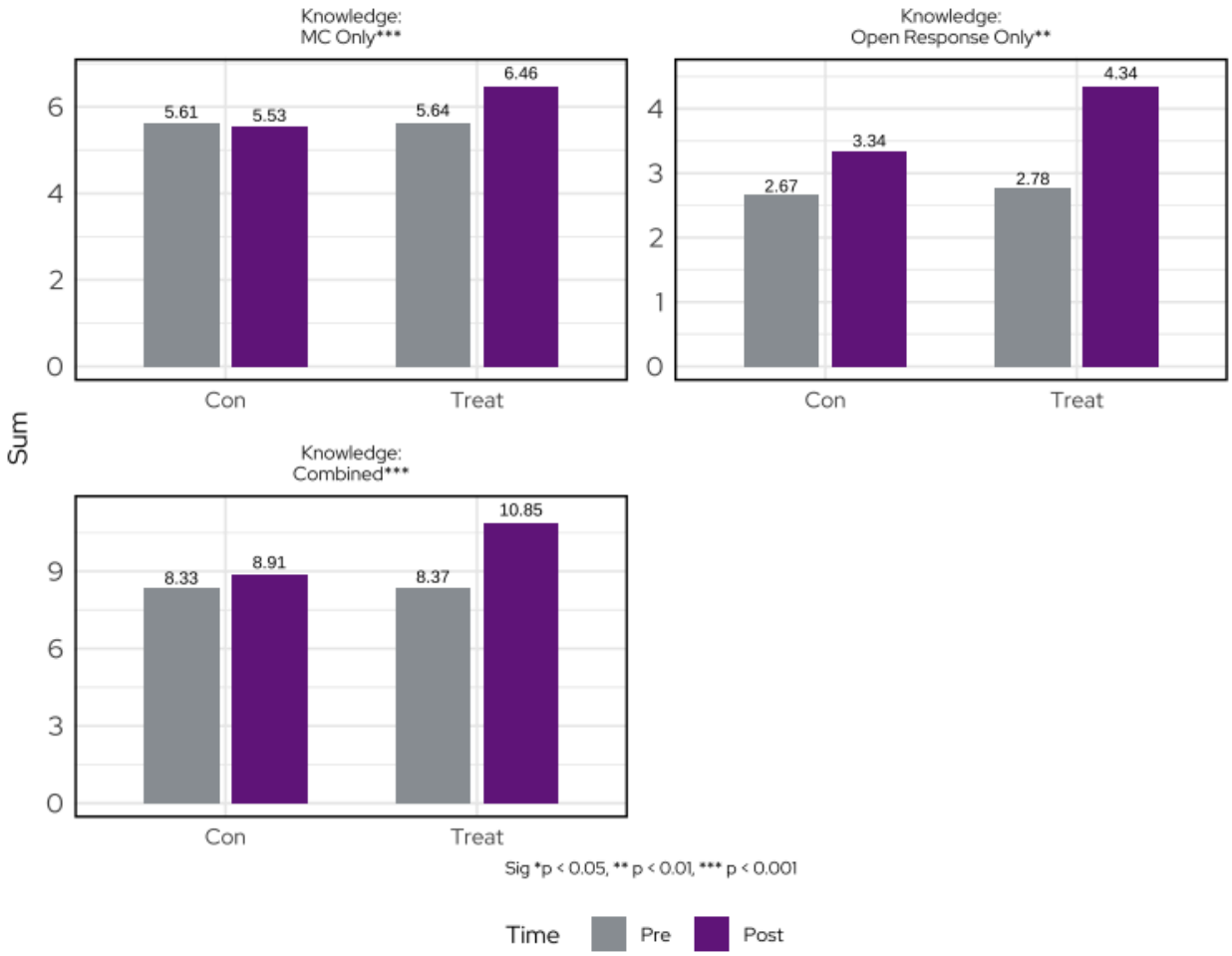


Impact on Students' Knowledge and Attitudes

Students in the treatment classes had significantly larger gains than students in the control classes on the multiple-choice ($\gamma_{01} = 0.93$, $d = 0.64$, $p < 0.001$), open-response ($\gamma_{01} = 1.00$, $d = 0.58$, $p < 0.01$), and combined outcomes ($\gamma_{01} = 0.93$, $d = 0.80$, $p < 0.001$). As part of the sensitivity analysis, we also tested models with teacher fixed effects and student demographics. There were no meaningful differences in effect sizes or changes in statistical significance when we added in these covariates, so we decided to report the results from the more parsimonious model with just the treatment indicator and the pre-test score. Figure 5 provides a visual representation of the treatment effects using the estimated marginal means. The full results from all tested models are in Appendix B.

[2] We excluded a few students (N = 6) who said they didn't remember using any of the resources in the collection.

Figure 5: Estimated Marginal Means for Knowledge Outcomes



By most conventional estimates, these effect sizes (0.58 - 0.80 standard deviations) are large for educational intervention. Although the specificity of the outcome measure may have increased the effect size, these factors need to be weighed against the fact that intervention was low cost to teachers and easily scalable, and it did not require extensive training.

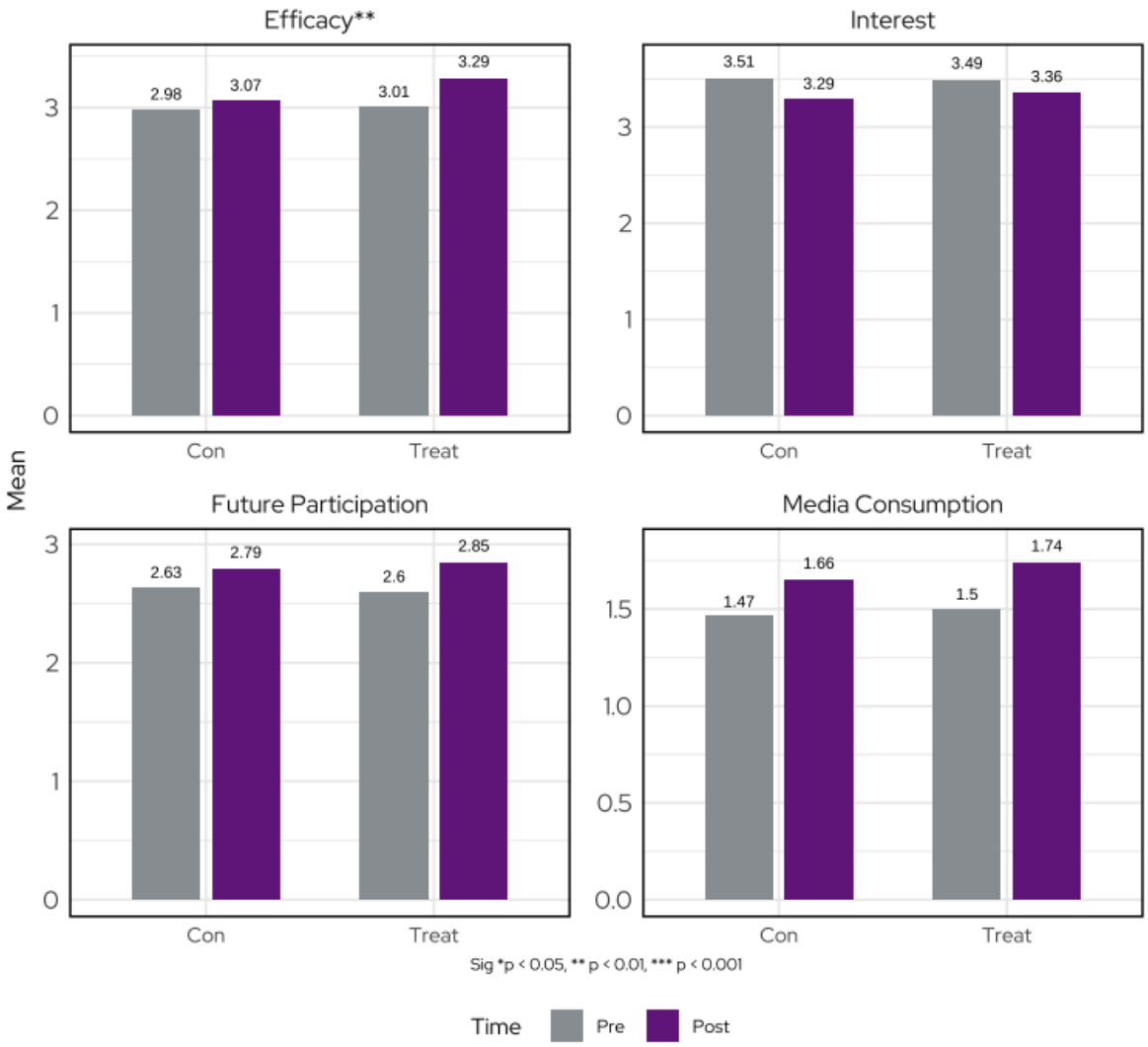
Students in the treatment classes had the largest gains for questions about the effects of nuclear weapons, nuclear weapons treaties, and the current state of nuclear weapons proliferation. For example, students in the treatment classes scored 39% higher on the post-test open-ended question about the risks of nuclear weapons beyond their use in warfare compared to only a 7% increase for the students in the control classes. Additionally, students in treatment classes scored 41% higher on a multiple-choice

question about the link between the decline in nuclear testing and the Nuclear Test Ban Treaty compared to only a 5% increase for the control classes. Finally, students in the treatment classes scored 29% higher on a multiple-choice question about the number of countries currently possessing nuclear weapons compared to a 6% decrease for students in the control classes.

Students in the treatment classes also had significantly larger gains in self-efficacy for advocating about nuclear policy (γ_{01} = 0.22,, d = 0.33, p < 0.01) than students in the control classrooms (Figure 6). This finding is significant because one might assume that students' self-efficacy might decrease after being exposed to the enormity of the nuclear weapons challenge. However, the examples provided of youth activists alongside the opportunity to advocate for their own beliefs via the Youth Media Challenge may have helped improve their self-efficacy.

There were no significant differences, however, in interest in nuclear weapons history and policy (γ_{01} = 0.07, d = 0.09, p > 0.1), plans for future participation in nuclear issues (γ_{01} = 0.05, d = 0.07, p > 0.1), and media consumption (γ_{01} = 0.09, d = 0.13, p > 0.1) (Figure 6). Both the treatment group and the control group reported statistically significant gains in plans for future participation and media consumption. One potential explanation for these results is that the study period overlapped with a period of increased press coverage of nuclear issues. Students in both the treatment and control classes may have been exposed to more coverage about nuclear weapons issues during the study time period.

Figure 6:: Estimated Marginal Means for Attitudinal Outcomes



Conclusion

The *Nuclear Weapons and Security Policy* collection on PBS LearningMedia has demonstrated significant success in reaching, engaging, and impacting thousands of students and educators across the United States. In our impact study, we have found that students in classes that were taught with these resources had greater gains in knowledge about nuclear weapons and had higher self-efficacy for engaging in advocacy around nuclear weapons compared with students taught with typical instruction. Through surveys and focus groups, we found supporting evidence that the collection materials engaged and inspired students and improved their overall understanding of these topics.

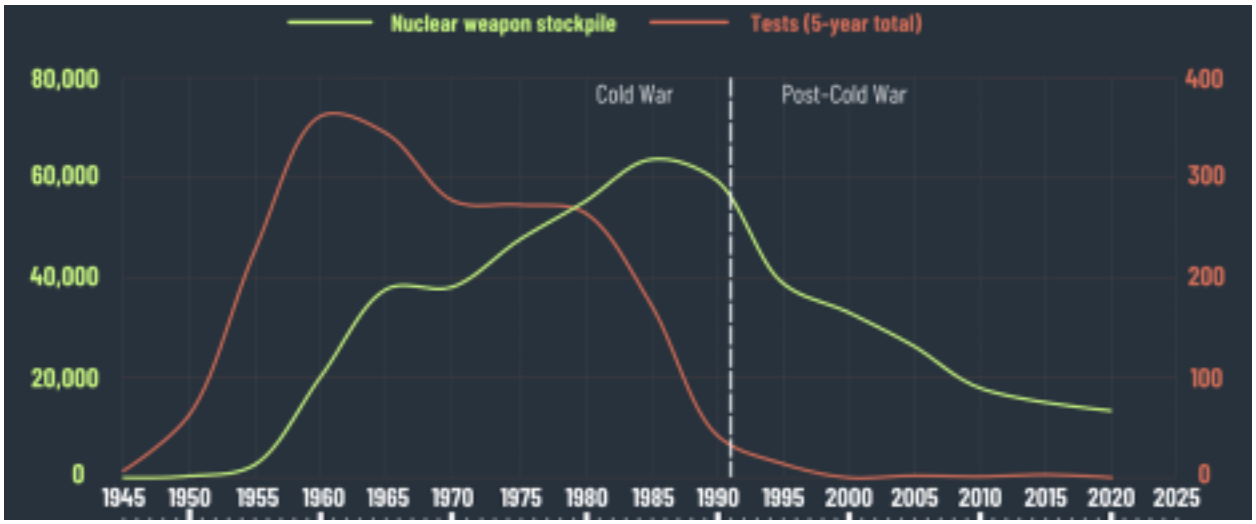
As the world continues to face the threat of nuclear weapons, more research is needed into how to best support teachers to address this critically important topic. Looking ahead, the GBH Education Research and Evaluation team plans to continue tracking usage and engagement metrics, conducting further research to better understand how these resources are used by teachers, and assessing longer-term impacts.

Appendix A: Survey

1. Nuclear winter is best described as
   a. The ice created immediately after any nuclear weapon is exploded
   b. The season during which nuclear weapons are developed and tested
   c. A potential environmental effect of nuclear war which will cause massive climate change and lead to widespread death correct
   d. The catastrophic blasts, heat, and radiation caused by a nuclear explosion

2. Which of the following is **NOT** true regarding nuclear weapon testing?
   a. Nuclear weapon testing has occurred in multiple locations including the Marshall Islands and within the continental United States
   b. Nuclear weapon testing sites are currently being expanded or updated in several nuclear-armed states
   c. Nuclear weapon testing indicates that the strength of nuclear weapons has remained constant over time correct
   d. United States military personnel and veterans have experienced negative health consequences as a result of nuclear weapon testing

3. Today, the expected trend for global stockpiles of nuclear weapons is that they will
   a. Increase correct
   b. Decrease
   c. Stay the same
   d. Be completely eliminated



4. What approximate year indicates the start of a decline in nuclear testing, and what might account for the decline?
   a. 1963; fewer nations had nuclear weapons
   b. 1963; the Partial Test Ban Treaty was enacted correct
   c. 1991; the Cold War ended
   d. 2000; North Korea was developing nuclear weapons

5. Fill in the blank. Nuclear weapon stockpiles were at their highest in _____ and the two nations who possessed almost all of these weapons were _____.
   a. The early 1960s; the United States and China
   b. Around 1979; China and Russia
   c. The mid-1980s; the United States and the Soviet Union correct
   d. 1985; Russia and North Korea

6. What is the primary purpose of nuclear deterrence?
   a. To encourage the use of nuclear weapons in war
   b. To prevent other nations from testing nuclear technology
   c. To discourage an enemy from attacking by threatening massive retaliation (correct)
   d. To eliminate all nuclear weapons globally

7. There are about 195 nations in the world today. How many of these countries possess nuclear weapons?
    a. Two
    b. More than two but less than 15
    c. About 50
    d. Over 100

8. Nuclear weapons are fueled by
    a. Fossil fuels like oil and natural gas
    b. Renewable sources like wind and solar power
    c. Radioactive elements like uranium and plutonium correct
    d. None of the above

9. Which nation(s) have been attacked using atomic weapons?
    a. The United States and Russia
    b. Japan correct
    c. North and South Korea
    d. Germany

OPEN RESPONSE:

10. Describe two risks of nuclear weapons other than the immediate effects of their use during a war.

11. *"With all of the history of war, and the human race's history, unfortunately has been a good deal more war than peace, with nuclear weapons distributed all through the world, and available, and the strong reluctance of any people to accept defeat, I see the possibility in the 1970s of the President of the United States having to face a world in which 15 or 20 or 25 nations may have these weapons. I regard that as the greatest possible danger and hazard."* - President John F. Kennedy 1963

a. What potential problem with nuclear weapons is President Kennedy describing in this quote?
b. What actions has the U.S. taken to address this problem?

13. Pick one of the following arguments about nuclear weapons and provide two pieces of evidence to support the argument.

    a. Owning nuclear weapons makes a country safer and less vulnerable to potential risks
    b. Owning nuclear weapons make a country less safe and more vulnerable to potential risks

Appendix B: Model Estimates

Model 1a: Unconditional Model (Multiple-Choice)

	post sc mc		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	5.94	5.56 – 6.33	**<0.001**
Random Effects			
σ^2	2.89		
$\tau_{00\ class\_id}$	0.58		
ICC	0.17		
N_{class_id}	23		
Observations	262		
Marginal R^2 / Conditional R^2	0.000 / 0.167		

Model 1b: Treatment and Pre-Test Scores Only (Multiple-Choice)

	post sc mc		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	2.42	1.74 – 3.10	**<0.001**
treatment	0.93	0.45 – 1.41	**<0.001**
pre sc mc	0.54	0.43 – 0.64	**<0.001**
Random Effects			
σ^2	2.14		
$\tau_{00\ class\_id}$	0.13		
ICC	0.06		
N_{class_id}	23		
Observations	262		
Marginal R^2 / Conditional R^2	0.334 / 0.373		

Model 1c: Treatment, Pre-Test, and Student Demographics (Multiple-Choice)

	post sc mc		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	2.37	1.16 – 3.58	**<0.001**
treatment	1.05	0.56 – 1.53	**<0.001**
pre sc mc	0.54	0.43 – 0.66	**<0.001**
gender [Male]	-0.18	-0.58 – 0.22	0.385
gender [Other]	-0.22	-2.35 – 1.91	0.838
gender [Prefer not to respond]	0.41	-1.72 – 2.55	0.702
race recoded [Black]	0.20	-0.92 – 1.33	0.722
race recoded [Latino]	0.09	-1.02 – 1.20	0.876
race recoded [Middle Eastern or North African]	-1.43	-3.71 – 0.85	0.218
race recoded [Multiracial]	0.19	-0.92 – 1.30	0.734
race recoded [White]	0.24	-0.72 – 1.21	0.620
college grad [No college or graduate degree]	-0.24	-0.65 – 0.17	0.248
Random Effects			
σ^2	2.14		
$\tau_{00\ class\_id}$	0.10		
ICC	0.05		
N_{class_id}	23		
Observations	235		
Marginal R^2 / Conditional R^2	0.357 / 0.387		

Model 1d: Treatment, Pre-Test, Student Demographics, and Teacher Fixed Effects (Multiple-Choice)

	post sc mc		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	2.98	1.56 – 4.39	**<0.001**
treatment	0.96	0.47 – 1.45	**<0.001**
pre sc mc	0.51	0.39 – 0.63	**<0.001**
teacher number [2]	-0.95	-1.92 – 0.03	0.057
teacher number [3]	-0.29	-1.13 – 0.55	0.494
teacher number [4]	-1.00	-2.07 – 0.07	0.066
teacher number [6]	-0.61	-1.89 – 0.67	0.348
teacher number [7]	-0.16	-1.36 – 1.05	0.796
teacher number [8]	-0.23	-1.25 – 0.80	0.660
teacher number [9]	-0.58	-1.39 – 0.22	0.152
gender [Male]	-0.13	-0.54 – 0.28	0.531
gender [Other]	0.10	-2.09 – 2.28	0.932
gender [Prefer not to respond]	0.35	-1.84 – 2.54	0.755
race recoded [Black]	0.31	-0.84 – 1.46	0.593
race recoded [Latino]	0.14	-1.01 – 1.28	0.814
race recoded [Middle Eastern or North African]	-1.38	-3.67 – 0.92	0.239
race recoded [Multiracial]	0.23	-0.90 – 1.37	0.686
race recoded [White]	0.33	-0.67 – 1.32	0.517
college grad [No college or graduate degree]	-0.24	-0.65 – 0.18	0.261
Random Effects			
σ^2	2.15		
$\tau_{00\ class\_id}$	0.10		
ICC	0.04		
$N_{\ class\_id}$	23		
Observations	235		
Marginal R^2 / Conditional R^2	0.380 / 0.407		

Model 2a: Unconditional Model (Open Response)

	post sc open		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	3.84	3.38 – 4.31	**<0.001**
Random Effects			
σ^2	3.75		
$\tau_{00\ class\_id}$	0.90		
ICC	0.19		
N_{class_id}	23		
Observations	261		
Marginal R^2 / Conditional R^2	0.000 / 0.193		

Model 2b: Treatment and Pre-Test Scores Only (Open Response)

	post sc open		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	1.80	1.22 – 2.39	**<0.001**
treatment	1.00	0.32 – 1.68	**0.004**
pre sc open	0.55	0.42 – 0.68	**<0.001**
Random Effects			
σ^2	2.96		
$\tau_{00\ class\_id}$	0.38		
ICC	0.11		
N_{class_id}	23		
Observations	259		
Marginal R^2 / Conditional R^2	0.260 / 0.344		

Model 2c: Treatment, Pre-Test, and Student Demographics (Open Response)

	post sc open		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	2.01	0.73 – 3.29	**0.002**
treatment	1.25	0.54 – 1.96	**0.001**
pre sc open	0.55	0.42 – 0.69	**<0.001**
gender [Male]	-0.33	-0.79 – 0.13	0.163
gender [Other]	0.94	-1.51 – 3.39	0.451
gender [Prefer not to respond]	-1.51	-3.99 – 0.97	0.232
race recoded [Black]	-1.03	-2.34 – 0.28	0.122
race recoded [Latino]	0.55	-0.75 – 1.85	0.403
race recoded [Middle Eastern or North African]	2.02	-0.60 – 4.64	0.129
race recoded [Multiracial]	0.45	-0.85 – 1.75	0.499
race recoded [White]	-0.23	-1.35 – 0.90	0.694
college grad [No college or graduate degree]	-0.03	-0.51 – 0.44	0.898
Random Effects			
σ^2	2.77		
$\tau_{00\ class\_id}$	0.42		
ICC	0.13		
$N_{\ class\_id}$	23		
Observations	233		
Marginal R^2 / Conditional R^2	0.325 / 0.413		

Model 2d: Treatment, Pre-Test, Student Demographics, and Teacher Fixed Effects (Open Response)

	post sc open		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	3.36	1.91 – 4.82	**<0.001**
treatment	1.14	0.60 – 1.68	**<0.001**
pre sc open	0.52	0.38 – 0.66	**<0.001**
teacher number [2]	-0.94	-2.00 – 0.13	0.084
teacher number [3]	-1.38	-2.31 – -0.45	**0.004**
teacher number [4]	-2.05	-3.26 – -0.83	**0.001**
teacher number [6]	-2.71	-4.14 – -1.29	**<0.001**
teacher number [7]	-1.03	-2.37 – 0.32	0.133
teacher number [8]	-1.13	-2.25 – -0.00	**0.049**
teacher number [9]	-1.38	-2.26 – -0.49	**0.002**
gender [Male]	-0.30	-0.76 – 0.17	0.213
gender [Other]	0.84	-1.64 – 3.32	0.506
gender [Prefer not to respond]	-1.57	-4.07 – 0.93	0.218
race recoded [Black]	-1.08	-2.39 – 0.23	0.106
race recoded [Latino]	0.48	-0.82 – 1.79	0.467
race recoded [Middle Eastern or North African]	1.84	-0.78 – 4.45	0.167
race recoded [Multiracial]	0.41	-0.90 – 1.72	0.538
race recoded [White]	-0.22	-1.36 – 0.92	0.701
college grad [No college or graduate degree]	-0.00	-0.48 – 0.48	0.991
Random Effects			
σ^2	2.79		
$\tau_{00\ class\_id}$	0.10		
ICC	0.03		
$N_{\ class\_id}$	23		
Observations	233		
Marginal R^2 / Conditional R^2	0.407 / 0.427		

Model 3a: Unconditional Model (Combined)

	post sc full		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	9.83	9.04 – 10.62	**<0.001**
Random Effects			
σ^2	8.17		
$\tau_{00\ class\_id}$	2.83		
ICC	0.26		
N_{class_id}	23		
Observations	260		
Marginal R^2 / Conditional R^2	0.000 / 0.257		

Model 3b: Treatment and Pre-Test Scores Only (Combined)

	post sc full		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	3.73	2.55 – 4.90	**<0.001**
treatment	1.94	0.95 – 2.94	**<0.001**
pre sc full	0.60	0.49 – 0.72	**<0.001**
Random Effects			
σ^2	5.89		
$\tau_{00\ class\_id}$	0.85		
ICC	0.13		
N_{class_id}	23		
Observations	258		
Marginal R^2 / Conditional R^2	0.369 / 0.449		

Model 3c: Treatment, Pre-Test, and Student Demographics (Combined)

	post sc full		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	3.76	1.72 – 5.80	**<0.001**
treatment	2.32	1.31 – 3.33	**<0.001**
pre sc full	0.60	0.48 – 0.72	**<0.001**
gender [Male]	-0.56	-1.22 – 0.11	0.101
gender [Other]	0.86	-2.61 – 4.34	0.624
gender [Prefer not to respond]	-1.51	-5.04 – 2.01	0.398
race recoded [Black]	-0.68	-2.54 – 1.18	0.470
race recoded [Latino]	0.70	-1.13 – 2.54	0.449
race recoded [Middle Eastern or North African]	0.64	-3.06 – 4.34	0.733
race recoded [Multiracial]	0.87	-0.96 – 2.71	0.350
race recoded [White]	0.12	-1.47 – 1.71	0.882
college grad [No college or graduate degree]	-0.12	-0.79 – 0.56	0.733
Random Effects			
σ^2	5.56		
$\tau_{00\ class\_id}$	0.84		
ICC	0.13		
$N_{\ class\_id}$	23		
Observations	232		
Marginal R^2 / Conditional R^2	0.413 / 0.491		

Model 3d: Treatment, Pre-Test, Student Demographics, and Teacher Fixed Effects (Combined)

	post sc full		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	5.64	3.21 – 8.07	**<0.001**
treatment	2.12	1.20 – 3.04	**<0.001**
pre sc full	0.57	0.45 – 0.70	**<0.001**
teacher number [2]	-1.72	-3.54 – 0.11	0.066
teacher number [3]	-1.60	-3.21 – 0.01	0.051
teacher number [4]	-2.61	-4.66 – -0.57	**0.013**
teacher number [6]	-3.25	-5.58 – -0.93	**0.006**
teacher number [7]	-1.26	-3.45 – 0.93	0.258
teacher number [8]	-1.32	-3.26 – 0.61	0.179
teacher number [9]	-2.00	-3.54 – -0.46	**0.011**
gender [Male]	-0.49	-1.17 – 0.18	0.152
gender [Other]	0.96	-2.57 – 4.48	0.593
gender [Prefer not to respond]	-1.48	-5.05 – 2.08	0.413
race recoded [Black]	-0.64	-2.51 – 1.22	0.498
race recoded [Latino]	0.72	-1.13 – 2.57	0.445
race recoded [Middle Eastern or North African]	0.55	-3.16 – 4.26	0.769
race recoded [Multiracial]	0.87	-0.98 – 2.73	0.355
race recoded [White]	0.18	-1.43 – 1.79	0.829
college grad [No college or graduate degree]	-0.09	-0.78 – 0.59	0.789
Random Effects			
σ^2	5.56		
$\tau_{00\ class\_id}$	0.55		
ICC	0.09		
$N_{\ class\_id}$	23		
Observations	232		
Marginal R^2 / Conditional R^2	0.466 / 0.514		

Model 4a: Unconditional Model (Self-Efficacy)

	post sc efficacy		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	3.16	3.06 – 3.27	**<0.001**
Random Effects			
σ^2	0.55		
$\tau_{00\ class\_id}$	0.01		
ICC	0.02		
N_{class_id}	23		
Observations	258		
Marginal R^2 / Conditional R^2	0.000 / 0.024		

Model 4b: Treatment and Pre-Test Scores Only (Self-Efficacy)

	post sc efficacy		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	1.72	1.39 – 2.05	**<0.001**
treatment	0.22	0.06 – 0.38	**0.008**
pre sc efficacy	0.45	0.34 – 0.55	**<0.001**
Random Effects			
σ^2	0.43		
$\tau_{00\ class\_id}$	0.00		
N_{class_id}	23		
Observations	258		
Marginal R^2 / Conditional R^2	0.237 / NA		

Model 4c: Treatment, Pre-Test, and Student Demographics (Self-Efficacy)

	post sc efficacy		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	1.95	1.37 – 2.52	**<0.001**
treatment	0.24	0.07 – 0.42	**0.007**
pre sc efficacy	0.47	0.35 – 0.58	**<0.001**
gender [Male]	-0.15	-0.32 – 0.03	0.101
gender [Other]	-0.24	-1.18 – 0.69	0.606
gender [Prefer not to respond]	-0.06	-0.99 – 0.88	0.901
race recoded [Black]	-0.08	-0.60 – 0.43	0.751
race recoded [Latino]	-0.37	-0.88 – 0.13	0.148
race recoded [Middle Eastern or North African]	-0.63	-1.64 – 0.39	0.224
race recoded [Multiracial]	-0.17	-0.67 – 0.33	0.507
race recoded [White]	-0.19	-0.64 – 0.25	0.393
college grad [No college or graduate degree]	-0.05	-0.23 – 0.13	0.582
Random Effects			
σ^2	0.43		
$\tau_{00\ class\_id}$	0.00		
$N_{\ class\_id}$	23		
Observations	231		
Marginal R^2 / Conditional R^2	0.277 / NA		

Model 4d: Treatment, Pre-Test, Student Demographics, and Teacher Fixed Effects (Self-Efficacy)

	post sc efficacy		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	1.81	1.15 – 2.47	**<0.001**
treatment	0.26	0.08 – 0.44	**0.006**
pre sc efficacy	0.47	0.35 – 0.60	**<0.001**
teacher number [2]	0.19	-0.17 – 0.55	0.300
teacher number [3]	0.15	-0.16 – 0.46	0.354
teacher number [4]	0.01	-0.39 – 0.42	0.957
teacher number [6]	-0.07	-0.58 – 0.43	0.772
teacher number [7]	0.24	-0.24 – 0.72	0.325
teacher number [8]	0.15	-0.24 – 0.53	0.452
teacher number [9]	0.05	-0.24 – 0.34	0.728
gender [Male]	-0.15	-0.33 – 0.03	0.105
gender [Other]	-0.34	-1.31 – 0.64	0.495
gender [Prefer not to respond]	-0.18	-1.15 – 0.80	0.717
race recoded [Black]	-0.05	-0.58 – 0.49	0.863
race recoded [Latino]	-0.37	-0.90 – 0.16	0.173
race recoded [Middle Eastern or North African]	-0.55	-1.59 – 0.49	0.296
race recoded [Multiracial]	-0.14	-0.67 – 0.39	0.604
race recoded [White]	-0.17	-0.64 – 0.30	0.480
college grad [No college or graduate degree]	-0.06	-0.24 – 0.13	0.553
Random Effects			
σ^2	0.44		
$\tau_{00\ class\_id}$	0.00		
$N_{\ class\_id}$	23		
Observations	231		
Marginal R^2 / Conditional R^2	0.281 / NA		

Model 5a: Unconditional Model (Interest)

	post sc interest		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	3.32	3.20 – 3.44	**<0.001**
Random Effects			
σ^2	0.91		
$\tau_{00\ class\_id}$	0.00		
N_{class_id}	23		
Observations	255		
Marginal R^2 / Conditional R^2	0.000 / NA		

Model 5b: Treatment and Pre-Test Scores Only (Interest)

	post sc interest		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	0.95	0.56 – 1.34	**<0.001**
treatment	0.07	-0.17 – 0.31	0.559
pre sc interest	0.66	0.56 – 0.76	**<0.001**
Random Effects			
σ^2	0.54		
$\tau_{00\ class\_id}$	0.03		
ICC	0.05		
N_{class_id}	23		
Observations	255		
Marginal R^2 / Conditional R^2	0.398 / 0.430		

Model 5c: Treatment, Pre-Test, and Student Demographics (Interest)

	post sc interest		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	0.91	0.29 – 1.53	**0.004**
treatment	0.09	-0.19 – 0.36	0.548
pre sc interest	0.73	0.62 – 0.83	**<0.001**
gender [Male]	0.12	-0.07 – 0.31	0.219
gender [Other]	-0.57	-1.57 – 0.42	0.259
gender [Prefer not to respond]	0.17	-0.84 – 1.17	0.744
race recoded [Black]	-0.20	-0.75 – 0.35	0.479
race recoded [Latino]	-0.45	-1.00 – 0.10	0.108
race recoded [Middle Eastern or North African]	-0.75	-1.83 – 0.32	0.169
race recoded [Multiracial]	-0.13	-0.68 – 0.41	0.629
race recoded [White]	-0.31	-0.79 – 0.17	0.208
college grad [No college or graduate degree]	0.04	-0.15 – 0.24	0.653
Random Effects			
σ^2	0.46		
$\tau_{00\ class\_id}$	0.06		
ICC	0.11		
$N_{\ class\_id}$	23		
Observations	228		
Marginal R^2 / Conditional R^2	0.477 / 0.535		

Model 5d: Treatment, Pre-Test, Student Demographics, and Teacher Fixed Effects (Interest)

	post sc interest		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	0.43	-0.34 – 1.20	0.272
treatment	0.16	-0.13 – 0.45	0.289
pre sc interest	0.75	0.64 – 0.85	**<0.001**
teacher number [2]	0.79	0.23 – 1.36	**0.006**
teacher number [3]	0.48	-0.04 – 0.99	0.069
teacher number [4]	0.30	-0.32 – 0.93	0.340
teacher number [6]	0.27	-0.45 – 0.99	0.456
teacher number [7]	0.50	-0.18 – 1.17	0.149
teacher number [8]	0.47	-0.14 – 1.08	0.127
teacher number [9]	0.30	-0.19 – 0.79	0.226
gender [Male]	0.10	-0.09 – 0.30	0.289
gender [Other]	-0.80	-1.81 – 0.21	0.121
gender [Prefer not to respond]	0.05	-0.97 – 1.06	0.925
race recoded [Black]	-0.19	-0.75 – 0.37	0.506
race recoded [Latino]	-0.46	-1.01 – 0.10	0.105
race recoded [Middle Eastern or North African]	-0.67	-1.75 – 0.40	0.219
race recoded [Multiracial]	-0.11	-0.66 – 0.44	0.699
race recoded [White]	-0.30	-0.79 – 0.18	0.220
college grad [No college or graduate degree]	0.03	-0.17 – 0.23	0.763
Random Effects			
σ^2	0.46		
$\tau_{00\ class\_id}$	0.06		
ICC	0.12		
$N_{\ class\_id}$	23		
Observations	228		
Marginal R^2 / Conditional R^2	0.482 / 0.545		

Model 6a: Unconditional Model (Future Participation)

	post sc future		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	2.81	2.69 – 2.93	**<0.001**
Random Effects			
σ^2	0.67		
$\tau_{00\ class\_id}$	0.02		
ICC	0.03		
$N_{\ class\_id}$	23		
Observations	257		
Marginal R^2 / Conditional R^2	0.000 / 0.033		

Model 6b: Treatment and Pre-Test Scores Only (Future Participation)

	post sc future		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	1.25	0.95 – 1.54	**<0.001**
treatment	0.05	-0.12 – 0.22	0.536
pre sc future	0.59	0.48 – 0.69	**<0.001**
Random Effects			
σ^2	0.46		
$\tau_{00\ class\_id}$	0.00		
$N_{\ class\_id}$	23		
Observations	257		
Marginal R^2 / Conditional R^2	0.331 / NA		

Model 6c: Treatment, Pre-Test, and Student Demographics (Future Participation)

	post sc future		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	1.54	0.97 – 2.11	**<0.001**
treatment	0.08	-0.10 – 0.26	0.394
pre sc future	0.60	0.49 – 0.72	**<0.001**
gender [Male]	-0.13	-0.31 – 0.05	0.152
gender [Other]	-0.60	-1.58 – 0.37	0.221
gender [Prefer not to respond]	-0.03	-1.00 – 0.93	0.946
race recoded [Black]	-0.11	-0.64 – 0.42	0.689
race recoded [Latino]	-0.36	-0.88 – 0.17	0.179
race recoded [Middle Eastern or North African]	-0.64	-1.68 – 0.41	0.234
race recoded [Multiracial]	-0.38	-0.90 – 0.14	0.147
race recoded [White]	-0.26	-0.72 – 0.20	0.258
college grad [No college or graduate degree]	-0.01	-0.20 – 0.17	0.914
Random Effects			
σ^2	0.46		
$\tau_{00\ class\_id}$	0.00		
$N_{\ class\_id}$	23		
Observations	230		
Marginal R^2 / Conditional R^2	0.368 / NA		

Model 6d: Treatment, Pre-Test, Student Demographics, and Teacher Fixed Effects (Future Participation)

	post sc future		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	1.30	0.65 – 1.95	**<0.001**
treatment	0.11	-0.08 – 0.29	0.247
pre sc future	0.61	0.49 – 0.73	**<0.001**
teacher number [2]	0.09	-0.28 – 0.46	0.628
teacher number [3]	0.24	-0.08 – 0.56	0.143
teacher number [4]	-0.31	-0.71 – 0.10	0.134
teacher number [6]	0.05	-0.46 – 0.57	0.843
teacher number [7]	0.28	-0.20 – 0.77	0.253
teacher number [8]	0.26	-0.13 – 0.65	0.192
teacher number [9]	0.13	-0.17 – 0.43	0.390
gender [Male]	-0.13	-0.32 – 0.06	0.167
gender [Other]	-0.56	-1.56 – 0.43	0.266
gender [Prefer not to respond]	-0.21	-1.20 – 0.78	0.671
race recoded [Black]	-0.03	-0.57 – 0.51	0.915
race recoded [Latino]	-0.30	-0.84 – 0.25	0.282
race recoded [Middle Eastern or North African]	-0.52	-1.57 – 0.54	0.335
race recoded [Multiracial]	-0.31	-0.85 – 0.23	0.258
race recoded [White]	-0.16	-0.64 – 0.32	0.507
college grad [No college or graduate degree]	-0.01	-0.21 – 0.18	0.884
Random Effects			
σ^2	0.45		
$\tau_{00\ class\_id}$	0.00		
$N_{\ class\_id}$	23		
Observations	230		
Marginal R^2 / Conditional R^2	0.390 / NA		

Model 7a: Unconditional Model (Media Consumption)

	post sc media		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	1.69	1.59 – 1.79	**<0.001**
Random Effects			
σ^2	0.56		
$\tau_{00\ class\_id}$	0.01		
ICC	0.01		
N_{class_id}	23		
Observations	255		
Marginal R^2 / Conditional R^2	0.000 / 0.014		

Model 7b: Treatment and Pre-Test Scores Only (Media Consumption)

	post sc media		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	0.70	0.45 – 0.95	**<0.001**
treatment	0.09	-0.10 – 0.27	0.361
pre sc media	0.65	0.50 – 0.81	**<0.001**
Random Effects			
σ^2	0.43		
$\tau_{00\ class\_id}$	0.01		
ICC	0.02		
N_{class_id}	23		
Observations	255		
Marginal R^2 / Conditional R^2	0.226 / 0.242		

Model 6c: Treatment, Pre-Test, and Student Demographics (Media Consumption)

	post sc media		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	1.08	0.54 – 1.62	**<0.001**
treatment	0.10	-0.10 – 0.30	0.321
pre sc media	0.61	0.45 – 0.78	**<0.001**
gender [Male]	-0.01	-0.19 – 0.17	0.922
gender [Other]	-0.44	-1.41 – 0.53	0.377
gender [Prefer not to respond]	-0.52	-1.49 – 0.46	0.295
race recoded [Black]	-0.21	-0.75 – 0.32	0.437
race recoded [Latino]	-0.36	-0.89 – 0.17	0.186
race recoded [Middle Eastern or North African]	-0.47	-1.52 – 0.59	0.387
race recoded [Multiracial]	-0.25	-0.78 – 0.28	0.348
race recoded [White]	-0.23	-0.69 – 0.24	0.339
college grad [No college or graduate degree]	-0.18	-0.37 – 0.01	0.063
Random Effects			
σ^2	0.46		
$\tau_{00\ class\_id}$	0.01		
ICC	0.02		
$N_{\ class\_id}$	23		
Observations	228		
Marginal R^2 / Conditional R^2	0.220 / 0.232		

Model 7d: Treatment, Pre-Test, Student Demographics, and Teacher Fixed Effects (Media Consumption)

	post sc media		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	0.82	0.19 – 1.45	**0.011**
treatment	0.10	-0.10 – 0.31	0.324
pre sc media	0.64	0.47 – 0.82	**<0.001**
teacher number [2]	0.30	-0.10 – 0.70	0.138
teacher number [3]	0.25	-0.10 – 0.60	0.163
teacher number [4]	0.62	0.18 – 1.06	**0.006**
teacher number [6]	-0.04	-0.58 – 0.51	0.898
teacher number [7]	0.20	-0.31 – 0.72	0.440
teacher number [8]	0.27	-0.16 – 0.69	0.217
teacher number [9]	0.15	-0.18 – 0.48	0.380
gender [Male]	0.00	-0.18 – 0.19	0.980
gender [Other]	-0.52	-1.52 – 0.47	0.300
gender [Prefer not to respond]	-0.56	-1.56 – 0.44	0.271
race recoded [Black]	-0.17	-0.72 – 0.38	0.536
race recoded [Latino]	-0.34	-0.89 – 0.21	0.224
race recoded [Middle Eastern or North African]	-0.34	-1.41 – 0.72	0.525
race recoded [Multiracial]	-0.23	-0.77 – 0.32	0.416
race recoded [White]	-0.24	-0.72 – 0.25	0.333
college grad [No college or graduate degree]	-0.20	-0.39 – -0.00	**0.047**
Random Effects			
σ^2	0.45		
$\tau_{00\ class\_id}$	0.01		
ICC	0.02		
N_{class_id}	23		
Observations	228		
Marginal R^2 / Conditional R^2	0.248 / 0.261		