Understanding STEM Through Integrated Contexts in Everyday Life

(USTRIVE)

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USTRIVE Partner Schools

THE SCHOOL DISTRICT OF PHILADELPHIA

PRISE · MERCYHURST UNIVERSITY · LASALLE UNIVERSITY · VILLANOVA UNIVERSITY · SAINT JOSEPH'S UNIVERSITY · ARCADIA UNIVERSITY

USTRIVE Quick Facts

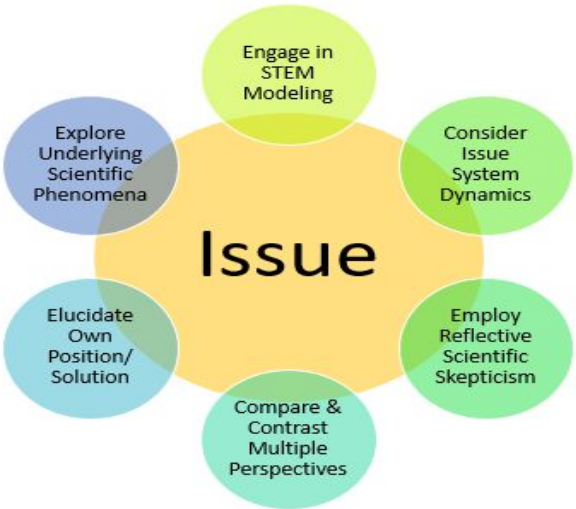
- $2.8 million, NSF Discovery Research K-12
- 4-Year Collaborative Project
- 75 grades 7-12 teachers and their students in 3 cohorts
- 2-Year commitment per teacher
- Focus on socioscientific & social justice

Group	Year 1	Year 2	Year 3	Year 4
Cohort 1	25 Teachers	As Peer Collaborators	Follow-Up Study	Follow-Up Study
Cohort 2		25 Teachers	As Peer Collaborators	Follow-Up Study
Cohort 3			25 Teachers	As Peer Collaborators

Socioscientific Issues (SSI)

- The SSI framework provides authentic entry points into science curricula that allow for the development of functional scientific literacy skills and to analyze multiple perspectives and varied sources of information on complex issues (Ziedler, 2014).
- SSI are authentic, real world, science based controversial issues that, when studied, require students to develop scientific content knowledge as well as moral and ethical reasoning (Zeidler & Nicols, 2009).
- Using SSI, teachers were able to compare not only trends in using renewable energy sources in Sicily vs. Pennsylvania, but they were also able to contrast societal practices such as using electricity, selecting houses and vehicles, and buying food, which impact carbon footprint (Macalalag et al., 2019).

Socioscientific & Sociotransformative



Example: Sugar tax and my body: regulating sugar consumption

Issues: Is sugar bad for you? Who should decide for individuals?

Scientific Phenomena: Sugars, proteins, fats

STEM Models: Health effects of sugar, health costs of sugar, taxation, health data/graphs on population, etc.

System: Government and individuals

Skepticism & Multiple Perspectives: Parents, students, healthcare professionals, lawmakers, business owners, sugar companies, health insurance, government insurance

Own position/solution: classroom debate, public service announcement products (examples: school assembly, local TV, school campaign, health day, partnership with organizations, etc.)

ARCADIA UNIVERSITY

Taken from Zeidler, D.L. & Kahn, S. (2014, page 4). *It's Debatable! Using Socioscientific Issues to Develop Scientific Literacy K-12.* Arlington, VA: NSTA Press.

Socioscientific Issues (SSI) Curriculum *is*	Socioscientific Issues (SSI) Curriculum *is not*
A research-based, interdisciplinary approach that enlists higher order problem-solving, argumentation, and research skills to analyze challenging, contextualized scientific concepts and issues.	A "cookbook" approach to scientific exploration that emphasizes "one right method" and predictable outcomes.
A method that uses real-world scenarios and real data in order to prepare students for their future roles as societal decision makers.	Simplistic use of hypothetical scenarios that are irrelevant to students' lives.
A conduit for scientific argumentation and discourse skills that mimic the manner in which real scientists research, discuss, debate, and deliberate scientific issues.	Emphasis on esoteric debates that allow students to contribute opinions rather than evidence.
A relevant and meaningful context for probing students' moral/ethical beliefs on controversial issues while guiding them to become tolerant and open to conflicting opinions and perspectives.	Reliance on "safe" subjects that avoid emotional connections and moral/ethical dilemmas.
A logical approach for modeling nature of science including the tentativeness of scientific conclusions, the importance of rational argument and skepticism, the role of creativity, and the distinction between	A traditional approach to scientific methodology, which fails to recognize the varying social, contextual, and personal influences that contribute to scientific progress.

This group (A) designed their lesson around the *SSI Issue* of Fast Food Limits. Their *Scientific Phenomenon* was macromolecules and nutrition, and they planned to incorporate *STEM Modeling* by having students design an experiment to analyze the nutritional content of food, and to consider the *Issue System Dynamics* of the politics behind the fast food industry and the economic implications for vulnerable communities. They planned to incorporate *Reflective Scientific Skepticism* by exposing students to counternarratives which address the supports the fast food industry provides to vulnerable communities, and to encourage students to *Elucidate Their Own Position/Solution* by having the students reflect upon their own stance on how the fast food industry should be regulated. This group did not incorporate *Multiple Perspectives* into their lesson plan.

This group's lesson is representative of the *Social, Cultural, and Political* theme.

USTRIVE Project Goals

- Develop, implement, and reflect on units of study that combine SocioScientific Issues/SociTransformative Constructivism (SSI/sTc);
- Cultivate pedagogical content knowledge (PCK) in teaching orientation and instructional strategies with regard to SSI/sTc;
- Acquire instructional design capabilities to develop and implement lesson plans, assessments, classroom resources, and reflections (i.e., units of study) that emphasize both STEM modeling (i.e., developing, testing and revising models) and the discursive nature of SSI (i.e., self-reflection and scientific skepticism); and
- Foster student scientific literacy through a cultural competence and sociopolitical consciousness instructional lens.

USTRIVE Teacher Participant Expectations

Year 1 (2021 - 2022)

- One year-long course held on Tuesday evenings
- Three workshop/field trip intensives on Saturdays
- Four classroom support visits (Year 1 only)
- One end-of-year conference with teacher-led workshops (Saturday)

Year 2 (2022 - 2023)

- Two-week summer institute (tentative: first two weeks of August)
- Monthly workshop/field trip intensives on Saturdays
- One end-of-year conference with teacher-led workshops (Saturday)

USTRIVE Teacher Compensation & Benefits

Teachers who participate in this program will have the opportunity to receive:

- up to $3,840 per year for attending the Tuesday classes, Saturday field trips and a year-end conference.
- up to $500 to purchase classroom materials
- apply to participate in a regional conference for educators.

USTRIVE School Commitment & Benefits

- Help recruit teachers
- Support teachers in their implementation of SSI/sTc units of study
- Participate in USTRIVE meetings and teacher-led conferences
- Support USTRIVE research activities
- Foster teacher leaders
- Cultivate students as change agents
- Utilize USTRIVE resources (e.g. classroom materials, supplies, expertise, collaboration, community resources)
- Join networks of STEM schools
- Promote your school

USTRIVE Research Questions

For ***Teachers***:

(1) In what ways, if any, do program activities support in developing teachers' PCK in instructional strategies with emphasis on the three elements of SSI: scientific, social, and (c) discursive?

(2) How does the teachers' PCK of students' understanding of SSI impact civic engagement as social agents of change?

(3) In what ways, if any, do teachers' dispositions change towards teaching with sTc? and

(4) What factors support and inhibit teacher leadership to promote SSI/sTc?

*For **Students***:

(5) How do justice-centered STEM lessons help students to develop elements of SSI (e.g. moral and ethical reasoning, scientific skepticism, STEM inquiry/modeling, SSI discourse/argumentation)?

(6) In what ways, if any, do students exhibit civic engagement as social agents of change through SSI?

USTRIVE Research Instruments

For Teachers

- Questionnaires
- Units of Study
- Classroom Observations
- Field notes from classroom visits
- Written Reflections
- Interviews
- Classroom Artifacts

For Students

- Audio-recorded group discussions (classroom visits)
- Fieldnotes of student interaction in groups
- Classroom- and community-based artifacts
- Audio-recorded student focus groups

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