Socioscientific Issues to Promote Discussions on Social Justice: Making STEM concepts accessible and relevant to everyday life experiences of grades 6-12 students

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Background

- The integration of Socioscientific Issues (SSI) in Science, Technology, Engineering, and Mathematics (STEM) classrooms can foster meaningful learning by engaging students in real-world, authentic problems that include moral and ethical decisions.[3]
- SSI, however, are ill-defined problems that cannot be resolved through science or mathematics alone and require the integration of multiple perspectives, evidence-based reasoning, and reflective scientific skepticism.[3]
- Teachers unfamiliar with the framework or its components require professional development (PD) and support to effectively plan and implement instructional activities.[1] PDs are also useful for helping teachers develop their pedagogical content knowledge (PCK), which is a combination of knowledge and teaching practices that directs teachers' actions while planning and implementing their lessons.[2]
- The Understanding STEM Teaching Through Integrated Contexts in Everyday Life (USTRIVE) project, funded by the National Science Foundation Discovery Research in K-12 federal grant, was developed to support the development of teachers' PCK and their efforts to learn about, plan for, and incorporate SSI in their classrooms.

Methods

- The study included 16 STEM teachers of varying experience levels and subject areas, with a majority teaching science only at the high school level (53%, n=9).
- Participating teachers developed a unit of study that aligned with their subject area and our SSI/sTc framework. Quantitative analysis of qualitative data was used to analyze the teacher-developed outlines for their unit, called storylines (n=16), describing the level of sophistication in the different domains and areas of SSI/sTc: social, STEM, discursive, and justice components. Storylines were evaluated on a three-level scale.
- Over the course of a two-week summer institute, teachers (n=16) engaged in a variety of activities aligned to the SSI/sTc framework. The events of each day were captured through professional development field notes taken by one research assistant. A qualitative analysis was used to code the PD field notes.
- Summer institute feedback forms and surveys were conducted by external evaluators from the Public Health Management Corporation's Division of Research & Evaluation Group.

Purpose

- This study aimed to explore the effectiveness of the USTRIVE project for facilitating SSI integration into participant teachers' lessons, particularly in fostering discussions of social justice in STEM classrooms.
- Research question: To what extent do teachers implement components of SSI in their unit of study?

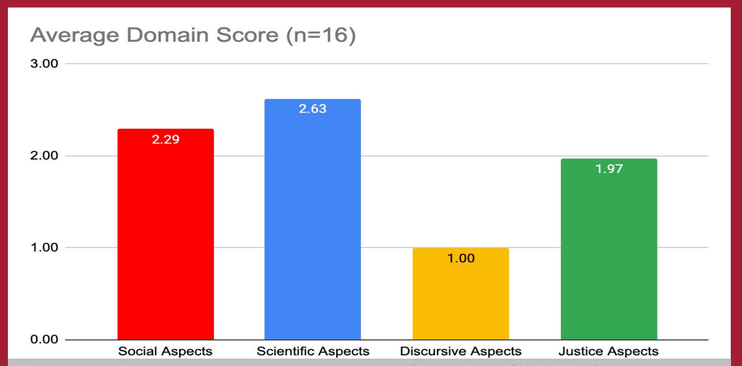

Figure 1. Average scores per domain from the SSI/sTc framework in teacher-developed storylines.

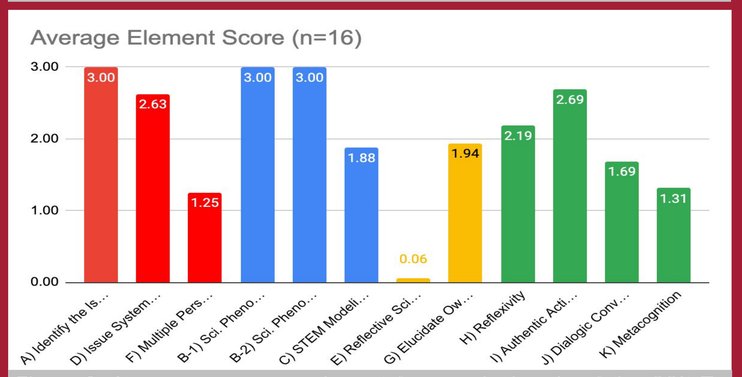

Figure 2. Average scores per element from each domain of the SSI/sTc framework in teacher-developed storylines.

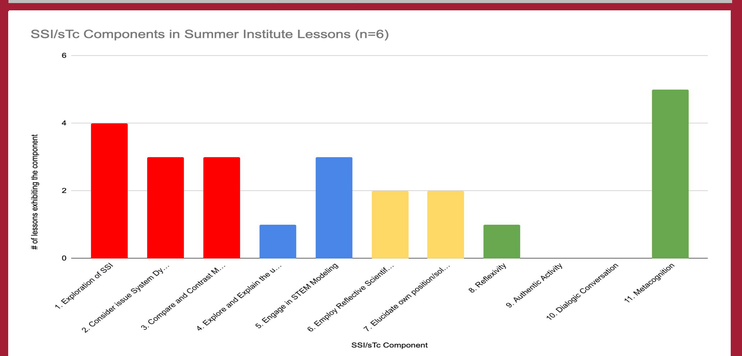

Figure 3. Number of elements from the SSI/sTc framework present in PD summer institute learning activities based on PD observational notes.

Results

- The analysis of teachers' storylines showed that the strongest component of SSI among teachers' units was the Scientific component (2.63), followed by the Social component (2.29), and the Justice component (1.97), while the weakest component was the Discursive component (1.00).
- The following findings were produced from the PD workshop field notes:
  - At least 50% of the PD activities addressed the social aspects of exploring the SSI, considering issue system dynamics, and comparing and contrasting multiple perspectives.
  - Half of the lessons focused on scientific aspects, while only one lesson explored and explained the underlying phenomena. The other lessons emphasized STEM modeling and its application.
  - Two out of six lessons (33%) focused on discursive aspects of SSI/sTc, with equal emphasis on reflective scientific skepticism and elucidating one's own position/solution.
- The external program evaluation showed that teachers had positive reactions to the PD, with strong agreement that the atmosphere was collegial and safe for sharing opinions. The majority of teachers reported using what they learned in the PD in their practice, particularly from the summer institute, and found the Professional Learning Communities to be helpful spaces for collaboration and honest feedback.

Discussion

- The USTRIVE project supported the development of teachers' PCK through planning and implementation of SSI lessons.
- The Scientific component was the strongest component of SSI among teachers, but they struggled with incorporating STEM modeling.
- Teachers were successful in incorporating system dynamics for the Social component, but struggled to provide scaffolding for exploring multiple perspectives and reflective scientific skepticism.
- Most teachers included authentic activity in the Justice component and identified real-world cases with relevant social justice issues to develop students' critical citizenship skills.

References

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