Current / Future Conceptual and Empirical Trends for Socioscientific Issues and Scientific Literacy

Dana L. Zeidler
The Best Minds of SSI
SSI

- Utilize controversial and ill-structured problems that require scientific evidence-based reasoning to inform decisions about such topics.

- Employ the use of scientific topics with social ramifications that require students to engage in dialogue, discussion, debate and argumentation.

- Integrate implicit and/or explicit ethical components that require some degree of moral reasoning.

- Emphasize formation of virtue and character as a long-range pedagogical goal.
We Teach “Proxies” of Key Learning*

*Thanks to Dr. Howard Johnston, Professor Emeritus USF for sharing these ideas

- Algebra a proxy for symbolic and abstract thinking
- Geometry a proxy for logic
- History/social studies a proxy for conflict, social processes, and change
- Literature a proxy for human behavior and self-expression
- Science a proxy for inquiry and skepticism
Curriculum for Effective Relationships –
Underlying Premise is that Relationships lie at the heart of the learning process and are fundamental to improving outcomes for all our children and young people.

- Communication & Collaboration: One-to-one, in Teams, In Family, In Community, At Work, Online
- Empathy Ethics (Emotional Literacy)
- Politics
- Citizenship
- Negotiation
- Conflict Resolution
- School Ethos and Culture
Under the SSI framework, justification of moral actions must be derived from discussion, rhetoric and argument concerning the normativity of different values.
Normativity of Values in Science Education

Bifurcation of Science

Fact

Non-normative components

- data gathering
- observation
- predicting
- scientific methods and processes
- measuring
- inferring
- concluding
- process skills

[Distinction?]

Value

Normative components

- prescribing courses of action
- choosing to create selected products
- decisions about what ought to be done
- considering multiple perspectives
- perspective-taking
- exercising conscience
- considering social / ecojustice issues
Bifurcation of Science
(Myth of Fact-Value Distinction)

“We cannot always draw a line between scientific thinking and “mere” philosophy because all data must be interpreted against a background theory, and different theories come bundled with a fair amount of contextual reasoning.” (Harris, 2010, pp. 179-180 – italics added)
Bifurcation of Science Threatens Community

Pitting Non-normative vs. Normative Views leads to...

Abdication of any sense of responsibility
Democratic group decision-making, facilitating understanding, fostering human values and caring and nurturing emotional intelligence are central in a SSI classroom and recognized as building blocks of character.
Scientific Literacy as Responsible Decision-making

While literacy may not require a moral compass, scientific literacy, in the sense that I am prescribing, does.
Scientific Literacy as Character Considerations

By participating in carefully designed, socially responsible activities, students will hopefully develop or have reinforced such qualities as reliability, trustworthiness, dependability, altruism, and compassion.
About 250 References Related to aspects of SSI selected for inclusion

Conceptual and Empirical Scholarship

Studies more central or are good “exemplars” relative to a selected theme are usually described in more detail, while others that support that theme tend to be clustered together.
SSI necessarily taps into personal values and affective emotions, moral-ethical principles, and matters of social importance.


Need to harness emotions and values and focus them on the implementation of social actions that can possibly reform and transform societal practices.

Hodson (2010), Levinson (2012), Santos (2009)

Advocates of Actor-Network Theory emphasizes any attempt which privileges scientific reasoning on matters related to SSI, but neglects to consider and attend to the normative factors (e.g., motivations, personal values, social milieu, Zeitgeist) that infiltrate these issues will likely fail.

(Fountain, 1999; Fioravanti & Velho, 2010; Latour, 2005)
① integrating principles, values and practices that promote world sustainability and prudent development

② rethinking all conventional aspects of teaching and learning

③ emphasis on curricula and teaching practices that promote values-based learning, interdisciplinary and holistic approaches (in contrast to only subject-specific learning)

④ emphasize critical reasoning over memorizing.

⑤ use of multiple methods of instruction (e.g., writing, art, drama, debate, etc.)

⑥ practice of participatory decision-making

⑦ use of information that is locally relevant to students
Continuum Contrast of Instructional Paradigms (Zeidler, Applebaum & Sadler, 2011).

- Traditional
  - Focus of Education
  - Epistemology Developed by
  - Learning Environment
  - Learning Outcomes Derived by

- Socioscientific Issues Approach
  - Emphasis on
    - Evidence-based Reasoning
    - Moral Concerns/ Ethical Issues
    - Character Formation / Conscience
    - Scientific Inquiry
    - Controversial Issues

- Progressive
  - Focus of Education
  - Epistemology Developed by
  - Learning Environment
  - Learning Outcomes Derived by

- Accountability
- Responsibility
- Teacher Centered
- Student Centered
- Faith
- Autonomy
- Dependence
- Action or Deeds
Four Broad Themes

I. Socioscientific Issues as Engagement of Curriculum Practice and Teachers’ Pedagogical Beliefs

II. Socioscientific Issues as Epistemological Development and Reasoning

III. Socioscientific Issues as Context for the Nature of Science

IV. Socioscientific Issues as Character Development and Citizenship Responsibility
I. Socioscientific Issues as Engagement of Curriculum Practice and Teachers’ Pedagogical Beliefs

- SSI AND TEACHER PRACTICES
- SSI AND TEACHER IDENTITY
- SSI AND WEB-BASED ENVIRONMENTS

**Summary:** SSI research has demonstrated the ability to connect contemporary science teaching and curricula to a good measure of relevance for students’ worldviews.

Focus on teacher identity shows promise in how teachers situate themselves as a conduit that connects science to larger sociocultural frameworks.

High level of student engagement when SSI inquiry is implemented, allowing teachers to best match their curriculum to local needs and student interests.

Utilization of web-based environments also shows promise to scaffold instruction.
II. Socioscientific Issues as Epistemological Development and Reasoning

SSI AND EPISTOMOLOGICAL BELIEFS

SSI AND REASONING ABOUT CONTENT KNOWLEDGE

SSI AND PATTERNS OF INFORMAL REASONING, ARGUMENTATION AND DISCOURSE

Summary:

SSI curricula coupled with teaching strategies meant to induce cognitive and moral dissonance have been found to promote developmental changes in reflective judgment.

Students utilized science in the process of expressing ideas they deemed relevant. A lack of conceptual understanding of scientific content hindered students’ ability to demonstrate high quality reasoning. Science content scores significantly improve.

Socioscientific reasoning, or the ability to evoke epistemological traits related to empathy that entail recognizing complexity, multiple perspectives, understanding inquiry and possessing skepticism may very well represent a mode of universal reasoning useful across a plethora of contextualized SSI.

Core beliefs are found to produce fallacious reasoning or prevent conceptual understanding of arguments, discourse and the co-construction of scientific knowledge.
Summary: Through SSI scenarios, students can come to appreciate how concepts such as understanding tentativeness, the role of empirical evidence, socio-cultural factors and the like, inform many of the inquiry processes associated with scientific discussions, decision-making and investigations.

Caveat:

While SSI can provide a sociocultural context for the facilitation of more robust NOS understanding, it cannot be assumed that students come to such realizations in the absence of explicit connections and examples.
Summary:

General goal: facilitation of ecological and democratic stewardship.

SSI cannot be disconnected from an awareness of others’ perspectives.

Multiperspectival: personal, societal and global perspectives research on SSI implementation has focused on means to enhance moral sensitivity by establishing a sense of community in the classroom and beyond its walls, thereby promoting participatory citizenship and democratic values, and even social/environmental activism.

Studies have fostered character and values via constructs centered around ecological worldviews, social and moral compassion, and socioscientific accountability.
I. Socioscientific Issues as Engagement of Curriculum Practice and Teachers’ Pedagogical Beliefs

How can preservice and inservice programs best develop teachers’ identity toward SSI and related humanistic approaches to science education?

How can SSI curricula be leveraged to facilitate environmental commitments and related socio-political action?
II. **Socioscientific Issues as Epistemological Development and Reasoning**

What methods ensure conceptual understanding and scaffolding of scientific content through all forms of SSI and SSR discourse?

What intellectual and psychological constructs (e.g., cognitive, sociomoral, moral reasoning, perspective-taking) contribute in fundamental and meaningful ways to SSR?
III. Socioscientific Issues as Context for the Nature of Science

How can scientific inquiry in SSI contexts be used to promote and broaden students’ understanding of NOS?

What are the underlying connections between moral and ethical issues undergirding SSI and their impact on NOS conceptualizations?
IV. Socioscientific Issues as Character Development and Citizenship Responsibility

How can the SSI framework be informed by related areas of research to develop students’ sense of responsibility, civic obligation and activism?

How can cross-cultural research on SSI better inform conceptualizations of social, global and environmental responsibility?
Thank You!
Zeidler@usf.edu