STSE Education
Current trends and Challenges

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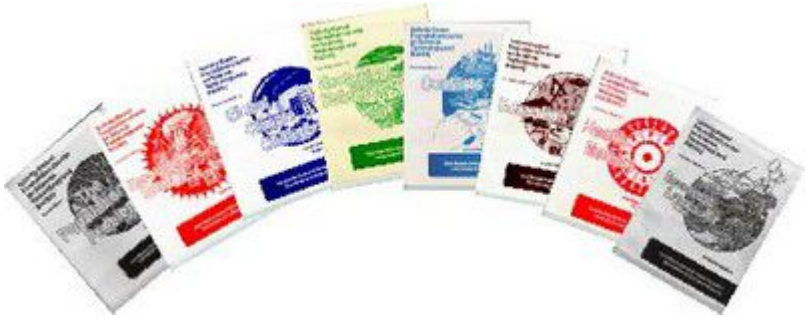
- In the 1990s—Science Technology Society and Environment Education (STSE education)
- *Activity based foundation curriculum on*

  STS: A series of 8 books.

  Other collaborators:

  Prof. Mahajan and

  Prof. Chunawala



- Science-Technology-Society course

  (2008)

Overview of the talk

- A historical account of STSE Education
- Current trends
- Research on Socioscientific Issues and Critical scientific literacy
- Illustrating the example of commercial surrogacy and its pedagogical potential as an issue that can be used to inculcate critical thinking skills
- STSE in the Indian science curriculum—concerns
- Concluding thoughts

STSE Education

- Macrolevel: STSE education- interface between science and the social world (Pedretti & Nazir, 2010).
- Places science squarely within the social, technological, cultural, ethical and political contexts
- Came up - in response to increased emphasis on academic science in the curriculum
- STSE-context for learning science, enhancing interest in science
- Democratic goal: Imparting skills to engage with issues at the interface of science, technology and society -- considerations other than science also get focus

A brief History of the field - International literature

- **Movements world over** - In 60s and 70s – environmental, pacifist, health movements -science under scrutiny- Curriculum-responded to these concerns

- Jim Gallagher's paper in Science Education in 1971 where he makes the case for an education apart from concepts and skills.

- **Prominent researchers in the field:**
  Through the late 70s through 80s- Paul Hurd (USA), John Ziman (UK)
  90s -Joan Solomon (UK) and Aikenhead (Canada).

PROGRAMS AND CURRICULA: 70s-80s-90s

-Science In Social Context (SISCON) (1978) and

-Science and Technology in Society (SATIS) in UK

-PLON in Netherlands-70s

[PLON- dutch acronym for Physics in personal, social and scientific contexts]

- Science – A way of knowing (Canada) -1970s (Aikenhead & Fleming)

- India- HSTP -70s, Activity based foundation on Science, Technology and Society, HBCSE (late 90s)

CURRENT SCENARIO

- **Policy level:** Many of the national policy documents also emphasize STSE outcomes.
- **STSE curricula**: Salters' advanced chemistry (UK); Science and Technology Education Promoting Wellbeing for Individuals Societies and Environments (STEPWISE) (Canada), Chemistry in Context (USA), A people's curriculum for the earth (Rethinking schools), USA

STS in India

Larger STS discourses – Role of science in society

- Science for modernisation argument -Nehruvian vision-- Scientific Temper- science, technology and development
- Science for liberation argument- People's Science Movement (PSM): Science as a tool for social change
- Science as violence argument – Postmodern and Neo-gandhians-- Nexus of science -state -development-- against the ideals of justice and equity (Ashis Nandy, 1988, Viswanathan,88, Ravirajan, 2005)

Movements against S&T related development – Narmada Bachao Andolan (Sardar Sarovar Dam), women's health movement in the 90s- reproductive technologies, Chipko Movement, anti-nuclear energy protests at *Kudankulam*

Movements and initiatives with STSE Education focus

- Kerala Shastra Sahitya Parishad (KSSP) in early 1960s –work in taking science to the people—vernacular language, confronting superstitions, advocacy on health and environment, critiquing development projects of which S&T are also part
- Bharat Gyan Vigyan Samiti (BGVS) and All India People Science Network in late 80s
- School curriculum initiatives:The Hoshangabad Science Teaching Program 1972

Current trends in STSE education

Six currents in STSE in terms of their focus, Aims of science education, Dominant approaches & Strategies (Pedretti and Nazir, 2010)

Current	Focus
Application/ design based	Problem solving through design & technology taking into consideration social economic, environmental contexts (Solomon, 1993, Layton,1988)
Historical	Presenting scientific ideas in a historical context to motivate students' interests in science – science as a human endeavor (Abd-El-Khallick & Lederman,1994, Mathews,1994)
Logical reasoning	Decision making about controversial socioscientific issues (SSI) through consideration of empirical evidence/application of science (Ratcliffe, 1997, Driver, Newton & Osborne, 2000)
Value -based	Decision making about controversial socioscientific issues focusing on values, moral development (Zeidler et.al, 2002, Allchin, 1999)
Socio-cultural	Presenting science as a cultural achievement but not as a superior form of knowledge, Engaging learners from diverse backgrounds, validating alternative ways of knowing (Aikenhead, 1997)
Socio-ecojustice	Critiquing or solving social and environmental problems through action (Hodson, 2003, Pedretti, 1997, Calabrese Barton, 2001)

More about six currents...

Overall, the focus of strands differ.

Some - interested in increasing appreciation and accessibility of science - science as a human endeavor or using socioscientific issues (SSI) as a context for learning science or applying science.

Other strands -- focus -not science alone; explore dimensions such as values, worldviews, other forms of knowledge - negotiating SSI. May involve critical approaches to science as well (socioecojustice framework)

SSI and Critical Scientific Literacy

Area of work: SSI as a means to achieve critical scientific literacy

Critical SL advocates envision **politicized Science Education**- question power relations and foster social justice concerns.

Students "... need to recognize that scientific and technological decisions are taken in pursuit of particular interests, justified by particular values and sometimes implemented by those with sufficient economic or political power to override the needs and interests of others."

" Many teachers avoid confronting the political interests and social values underlying the scientific and technological practices they teach about, and seek to avoid making judgements about them or influencing students in particular directions."

Opportunities—for students to engage with issues that have a scientific technological, and environmental dimension.

Derek Hodson (2003). Time for action: Science education for an alternative future

Socioscientific Issues (SSIs)

- Social Dilemmas with conceptual or technological links with science (Sadler, 2004) such as issues related to health and environment and technologies e.g. global warming, genetic engineering dilemmas.
- Real world issues, controversial in nature
- Need for SSI as a part of science curriculum- Undergraduate and High school Science Curricula (Zeidler and Keefer, 2003; Hughes,2000).
- Research underway looking at students negotiation of SSI (Sadler, 2004, Hodson,2011)

How researchers understand "Negotiation of SSI" influenced by – how they understand the relationship between science and society

- Ralph Levinson (2007)-identifies a range of such frameworks – based on how technocratic they are.
- **Technocratic frameworks**

  -Stress importance of canonical scientific knowledge in resolving issue,

  -Authority of experts.

  -Scientific knowledge-applied to social problems.
- **Non-Technocratic frameworks**

  -Central role of science de-centred, tentative and uncertain, scientific knowledge-challenged.

  -Other forms of knowledge also privileged -- Anecdotal /experiential knowledge: knowledge that lay people bring to bear on socioscientific controversies -- contradict expert knowledge. e.s. Bryan Wynne (1989) study- post Chernobyl nuclear power plant disaster-British scientists underestimated level of contamination in catte-Cumbria and Wales. Farmers-contradicted the scientists based on their experiential knowledge.

  -Experts and lay people co-participants

My work: Non-technocratic view of science-society relationship

--SSIs-need to be collaboratively resolved by lay people/students, experts and teachers.

--Scientific knowledge, anecdotal knowledge, values and worldviews need to be considered when negotiating these issues.

--Students need to be sensitized to ideals of social justice when they are engaging with these issues.

Technology related SSI and critical SL

- Hodson (2003)-underlines- importance of using problems and issues related to technology to foster critical SL.
- Technology- all pervasive, discussed in print and visual media.
- Easier to see how technology is impacted by the sociocultural context than science
- Issue: Commercial Surrogacy – whether students believe that gestational surrogacy is an appropriate option for infertile parents to have children

ARTs and Commercial Surrogacy

- Assisted Reproductive Technologies (ARTs) enable people who cannot reproduce by biological means to do so.
- In-vitro-fertilisation (IVF) – ART
- Users: Men with low sperm motility, Woman with uterine problems, Single men, women or same sex couples.
- Procedure: Extraction of male and female gametes, external fertilization of these gametes , reimplantation in body of a female.
- 3rd person (female) involved- gestational surrogacy. Commercial surrogacy.

  These surrogate mothers--poor
- India- status of surrogacy capital. "Baby factory" "outsourcing wombs."
- Infertility industry-unregulated in India. ICMR in 2008 has come up with ART bill.
- Issue-- of relevance to students: Textbooks have reference to IVF/ “Test tube babies”, Media reports: surrogacy

Have you heard of test tube babies?

Boojho and Paheli's teacher once told them in the class that in some women oviducts are blocked. These women are unable to bear babies because sperms cannot reach the egg for fertilization. In such cases, doctors collect freshly released egg and sperms and keep them together for a few hours for ***IVF*** or ***in vitro fertilization*** (fertilization outside the body). In case fertilization occurs, the zygote is allowed to develop for about a week and then it is placed in the mother's uterus. Complete development takes place in the uterus and the baby is born like any other baby. Babies born through this technique are called **test-tube babies**. This term is actually misleading because babies cannot grow in test tubes.

Class VIII, NCERT

***In vitro* fertilisation** (IVF–fertilisation outside the body in almost similar conditions as that in the body) followed by **embryo transfer** (ET) is one of such methods. In this method, popularly known as **test tube baby** programme, ova from the wife/donor (female) and sperms from the husband/donor (male) are collected and are induced to form zygote under simulated conditions in the laboratory. The zygote or early embryos (with upto 8 blastomeres) could then be transferred into the fallopian tube (ZIFT–**zygote intra fallopian transfer**) and embryos with more than 8 blastomeres, into the uterus (IUT – **intra uterine transfer**), to complete its further development. Embryos formed by **in-vivo fertilisation** (fusion of gametes within the female) also could be used for such transfer to assist those females who cannot conceive.

Class XII, NCERT

Brief Description of my work

- Interviews/workshops – higher secondary biology students (16-17 years of age)
- Students were given a description of IVF, commercial surrogacy
- Probed on whether this is an appropriate option for infertile parents if they wished to have children biologically.

- Problem:

  As a researcher/teacher:

  -What considerations can I expect students to raise on this issue?

  -How do I understand the considerations that students raise on the issue?

- Ralph Levinson's framework (2006) -- what is at stake in an SSI
- Framework- examination of SSI at *multiple levels of disagreement (LoDs)*. Makes explicit what is at stake in the issue in terms of evidence, values and worldviews.
- Involves 9 non-exhaustive levels. The levels are not hierarchical.

  At level 1 and 2 sources of contention -related to evidence while at higher levels, issues like difference in ethical premises, personal experiences, indeterminacy of concepts and world-view

Parse the issue of commercial surrogacy in terms of what is at stake in it (on the basis of media debates/academic/ feminist scholarship surrounding the issue, examples from students responses)

@Level 1/2 (Evidence Related)

Issues related to evidence may be debated

-Health risks for surrogate mother, biological mother

-Success rate of IVF procedure

Students- need skills to evaluate conflicting reports on risks involved; reliability of sources of evidence

Evidence related to SSI-complex, conflicting and difficult to assess.

@ Level 3 (Weightage Related)

Students may agree that a given criteria is important, but may differ on weightage needed to be given to the criteria.

e.g. Most students agreed that any technology should be accessible to all but some students-- unsure whether IVF should be made affordable to all because “the poor cannot take care of their kids anyway”

@Level 4 (Ethical premises related)

Controversy related to lack of consensus between the parties on ethical premises.

Does surrogacy amount to "trading the body"?
Can bodies be bought and sold? Is it right to commodify bodies?

Do we really have the right to have a child? (Genetic family versus social family)

Level 5 (Conceptual Issues Related)

Controversy due to difference in interpretation of concepts involved.

-What constitutes 'parenthood'? Does lending genetic material amount to parenthood? What about the role of the surrogate mother as a parent? (related to level 4)

-Are the surrogates making a 'choice' to rent their wombs? Is a choice motivated by poverty a “free choice”?

Is the surrogate mother being exploited'? Can a person 'choose' to be exploited ?

Level 6 (Interest Related)

Controversy due to different perspectives that arise due to difference in interest positions.

If participants look at commercial surrogacy from the interest position of commissioning parents, they may see it as justified. But from the perspective of surrogate mother, is it justified?

Level 8

Controversy due to differing 'total experiences' of people involved.

A person who has a personal experience with adoption may see IVF very differently from a person who has no experience of adoption.

Level 9 (World View Related)

Controversy over whole frameworks of understanding relevant for judgement.

Religion and social identities-- "Islam may not permit IVF because we have to be satisfied with what god gives us"

Role of the Teacher

- Taking students through the levels
- At level 1/2 (Evidence related):

  --Science in SSI (contentious, conflicting, value laden) // Science in textbooks (ready made science-established facts and concepts)

  --Help students sift through different sources of evidence, understand nature and reliability of evidence.
- Levels which involve values, world views and personal experiences

  Evidence may not help resolve the controversy. Communicative virtues- Respect, openness, willingness to listen, empathetic conceptual imagination

  -Personal Narratives

  -Documentaries, Role play

- Framework enables understanding issues in a structured manner. Useful for teachers as well as researchers.

  Social justice concerns can be raised and discussed.
- Scientific evidence is not privileged in resolution of controversy, though recognized as important.
- Recognizes other domains of knowledge- ethics, cultural worldviews and personal experiences.

Are we ready for SSI in the Indian Science Curriculum

- There is articulation of need for STSE outcomes in the NCERT Position paper on teaching of science:

  “While deciding on gradation of science curriculum, it must be borne in mind that a majority of students learning science as a compulsory subject up to Class X are not going to train as professional scientists or technologists in their later careers; yet they need to become ‘scientifically literate’, since several of the social, political and ethical issues posed by contemporary society increasingly revolve around science and technology. Consequently, the science curriculum up to Class X should be oriented more towards developing awareness among the learners about the interface of science, technology and society, sensitizing them, especially to the issues of environment and health, and enabling them to acquire practical knowledge and skills to enter the world of work.” (p.11, Position paper on the teaching of science)

- But at the same time it also points out:

  “...Facts, principles, theories and their applications to understand various phenomena are at the core of science and the science curriculum must obviously engage the learner with them appropriately” (p.12, Position Paper on the Teaching of Science)

- Pressures on the curriculum to balance disciplinary interests as well as to incorporate STS content.

- Prescription of science education at various levels.

  -Primary level-empasis on environmental studies (fuses science and social science): NCERT textbooks -- critical content where students are made to think of social justice concerns.

  - From upper primary level onwards, curriculum prescriptions and textbooks begin to emphasize content knowledge. At the higher secondary level STS – co-curricular prescription.

Concluding thoughts

- Need to introduce SSI at school level and undergraduate level as part of *formal* curriculum.
- Science curriculum or not needs to be debated.
- School level- integrated themes/projects that cut across subjects and involve teachers in cross-disciplinary collaboration.
- Pedagogical skills needed to teach these issues—need to be in place.

Other Research scholars working in STSE

....THANK YOU!