TURS seminar for RSSCSE at Plymouth
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TURS: Promoting Teachers' Understanding of Risk in Socio-Scientific Issues

Teaching and Learning Risk in Schools

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Outline

1. What is risk? Discussion
2. The TURS project
3. Software → Rationale → Justification

1. What is risk? Discussion

Is this what risk is?

Is this what risk is?

2. The TURS project

The TURS Project: Promoting Teachers' Understanding of Risk in Socio-Scientific Issues

September 2008 – May 2010
(21 months)

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www.RISKatIOE.org

TURS: Promoting Teachers' Understanding of Risk in Socio-Scientific Issues

Key project aim

- Work with maths and science teachers to enhance the teaching of risk by:
  - developing pedagogical principles
  - developing software tools/simulations that support **reflection, sharing and perturbation** of teachers' knowledge about the teaching and learning of risk.

Significance of this research

- Teaching of socio-scientific issues and risk is already established in PSHE/Citizenship, and Science (to a limited extent)
- We are bringing the quantitative/mathematical perspective together with the socio-scientific, through teachers' inter-disciplinary working, and novel software designs

N.C. Programme of study KS4 Mathematics

The importance of mathematics:

- Mathematics equips students with uniquely powerful ways to describe, analyse and change the world…students who are functional in mathematics and financially capable are able to think independently in applied and abstract ways, can reason, solve problems and **assess risk**.

Key concepts:

- Applying suitable mathematics: This requires fluency and confidence in a range of mathematical techniques and processes that can be applied in a widening range of familiar and unfamiliar contexts, including managing money, **assessing risk**, problem-solving and decision-making.

Statistics:

- Probabilities: This includes **applying ideas of probability and risk** to gambling, safety issues and the financial services sector, and simulations using ICT to represent a probability experiment, such as rolling two dice and adding the scores.

[SOURCE: KS4 Maths Programme of Study, QCA, 2008]

N.C. Science (KS4)

Programme of study KS4 Science:

- How science works
- Data, evidence, theories and explanations
- Applications and implications of science

Pupils should be taught:

- About the use of contemporary scientific and technological developments and their benefits, drawbacks and **risks**.
- To consider how and why decisions about science and technology are made, include those that raise ethical issues, and about the **social, economic and environmental effects** of such decisions
- How uncertainties in scientific knowledge and scientific ideas change over time and about the role of the scientific community in validating these changes.

GCSE "21st Century Science" exam specification (OCR)

5 Risk

Every activity involves some risk. Assessing and comparing the risks of an activity, and relating these to the benefits we gain from it, are important in decision making.

	Ideas about science	A candidate who understands this…
5.1	Everything we do carries a certain risk of accident or harm. Nothing is risk free. New technologies and processes based on scientific advances often introduce new risks.	can explain why it is impossible for anything to be completely safe can identify examples of risks which arise from a new scientific or technological advances can suggest ways of reducing specific risks
5.2	We can sometimes assess the size of a risk by measuring its chance of occurring in a large sample, over a given period of time.	can interpret and discuss information on the size of risks, presented in different ways.
5.3	To make a decision about a particular risk, we need to take account both of the chance of it happening and the consequences if it did.	**can discuss a given risk, taking account of both the chance of it occurring and the consequences if it did**
5.4	People are often willing to accept the risk associated with an activity if they enjoy or benefit from it. We are also more willing to accept the risk associated with things we choose to do than things that are imposed, or that have short-lived effects rather than long-lasting ones.	can suggest benefits of activities that have a known risk can offer reasons for people's willingness (or reluctance) to accept the risk of a given activity can discuss personal and social choices in terms of a balance of risk and benefit
5.5	If you are not sure about the possible results of doing something, and if serious and irreversible harm could result from it, then it makes sense to avoid it (the 'precautionary principle').	**can identify, or propose, an argument based on the 'precautionary principle'**
5.6	Our perception of the size of a risk is often very different from the actual measured risk. We tend to over-estimate the risk of unfamiliar things (like flying as compared with cycling), and things whose effect is invisible (like ionizing radiation).	**can distinguish between actual and perceived risk, when discussing personal and social choices** **can suggest reasons for given examples of differences between actual and perceived risk**
5.7	Reducing the risk of a given hazard costs more and more, the lower we want to make the risk. As risk cannot be reduced to zero, individuals and/or governments have to decide what level of risk is acceptable.	**can explain what the ALARA (as low as reasonably achievable) principle means and how it applies in a given context**

Source:
OCR GCSE Science Specification

Inter-disciplinary potentials

- Most science teachers are teaching about risk as part of socio-scientific issues, in unquantified ways
- For most mathematics teachers, risk is a topic on the horizon of the revised National Curriculum which has not yet had impact on practice.
- We are interested in the scope for teachers' inter-disciplinary working to develop quantified approaches to risk that bring mutual benefits to the teaching of both subjects.

Iterative (co)design

We aim to capture teachers' knowledge about risk and about teaching and learning of risk, **and the processes of how these change**, through the iterative design of software

Inter-disciplinary working

We have worked with a small group of 8 teachers, formed of 4 pairs of mathematics and science specialists in the same schools.

3. Software →
   Rationale →
   Justification

Deborah's Dilemma: Information

Information about Deborah's Dilemma

- There are four buttons, each giving information as on your sheets.
- Read each sheet in turn.
- What would be your recommendation at the end of each?

The idea of risk

- Risk is a contested, even controversial concept.
- How is this reflected in school curricula and classroom practice?
- How should it be reflected in school curricula and classroom practice?

'Actual' ('Scientific') risk (the experts) and 'Perceived' risk (the public)

- Experts and 'the public' define risk differently [Eijkelhof, H. M. C. (1990). Radiation and risk in physics education, PhD thesis. Utrecht: Rijksuniversiteit Utrecht. p.150.]
- Scientists should focus on aspects of risk that can be understood and judged. [Medawar, quoted in Adams, 2005]
- Risk has no objective existence but science can provide guidance for that imagination. [Adams, 2005]

Quantifying Risk

Risk is about the decision-making of individuals and organisations, making judgements in the face of uncertainty

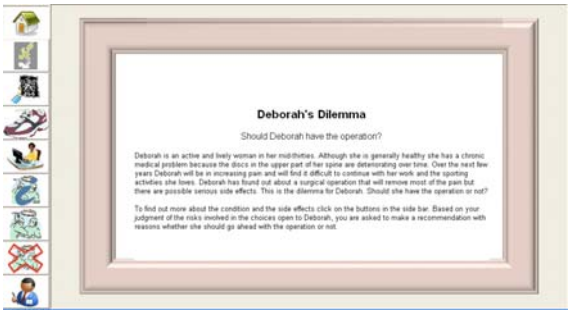
Pedagogical Theory Component One

Risk is a multi-disciplinary subject that <u>can</u> be (has to be!) addressed within conventional school structures.

Pedagogical Theory Component Two

Risk is multi-dimensional: likelihood, impact, ethical considerations,.... Recognition of the various dimensions can be stimulated by engaging with contextualised socio-scientific dilemmas and discussing the multi-faceted nature of each dilemma.

Deborah's Dilemma: Exploring consequences



Models and modelling of risk

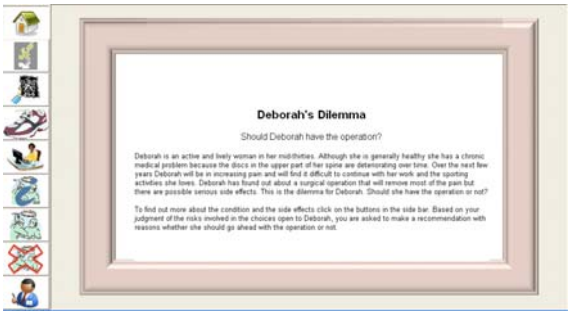
- Bringing together quantified and qualitative approaches…
- Personal models, Formal models
- Decision-making scenarios

Pedagogical Theory Component Three

A modelling approach that encourages making explicit the dimensions of specific contextualised socio-scientific dilemmas in executable models, and encourages awareness of the consequences of their characterisation of the dilemma.

Where would you position the various risks?

Deborah's Dilemma: Coordinating the dimensions

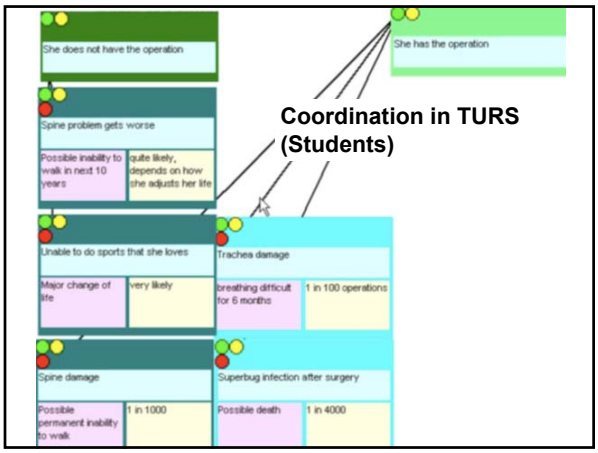


Coordination in TURS (Teachers)

- A tendency to flip between deciding for or against the surgery.
- A range of personal models.
- Estimates of impact were not quantified numerically, but in terms of severity (mild/medium/severe, of operation side-affects, and of everyday pain experience).
- Impacts of living with the pain seen as less severe but more probable than the impacts of surgery.

Coordination in TURS (Teachers)

- Richness in discussion:
  - Identity: 'Who is Deborah?'
    - 'Is doing high-impact sports central to her life?'
    - 'Does she have dependent children?'
  - Identity: 'Who are we?'
    - How valid is our information?
    - The responsibility of making a recommendation (e.g. Are we friends of Deborah?).



Pedagogical Theory Component Four

- *Expressive tools can be designed that support the co-ordination of the dimensions of risk*

Further discussion