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INTEGRATING RISK AS A CONTENT IN UPPER SECONDARY PHYSICS COURSES

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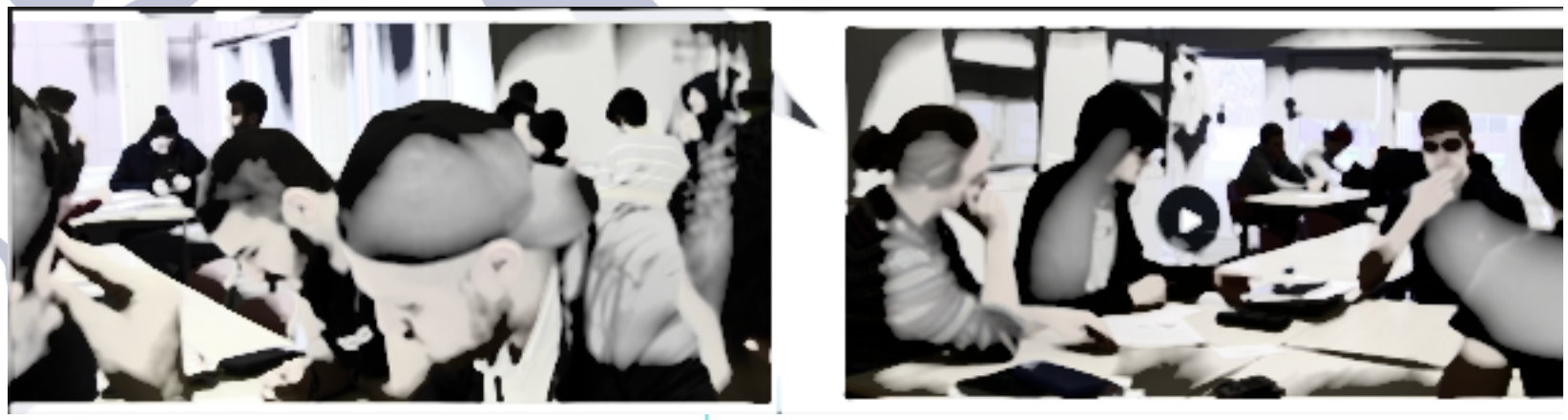

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RiskEdu – a multidisciplinary project team

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RiskEdu research questions:

What are the consequences of teaching risk and risk assessment as part of the school's natural sciences for:

A) Students' ability to make decisions based on risk assessments and formulate action options in current social issues?

B) for the students' learning of the subject content (Eg radiation), as it is judged in regular tests?

In what ways must risk education be conducted so that teaching about risk and risk assessment can support pupils' learning?

Design of the three years qualitative design study

Design 1, lesson moduls, year 15/16	Cycle 1: Data-collection Nuclear physics. What is risk?	Case study, analys from video- and planning talks, tests A first risk assessment
Design 2, lesson moduls, year 16/17	Cycle 2: Data-collection UV radiation, Risk assessments, how?	Case study analysis from video and written texts, group-talk, risk assessments
Design 3, lesson moduls Year 17/18	Cycle 3: Data-collection risk assessments, course nuclear physics	Risk assessment analysis of ”Strawberry-problems” in large classes

Theoretical framework and research purposes

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Risk is an important content - for scientific literacy - for decision making in socio-scientific issues.

Adams, 1995; Hansson, 2009; Christensen, 2009; Kelly, & Green, 1998; The Design-Based Research Collective, 2003; Schenk et al, in press; Enghag et al, 2017. McKenney, & Reeves, 2012

We present today results from the two first cycles of physics teaching. The results are a narrative of how the initial ideas were modified during the two cycles, and how these ideas were converted to tentative principles for designing physics teaching.

Researchers collaborate with teachers. Design changes are planned (interventions) and then implemented iteratively in the classroom situation. The aim is new theories for learning, teaching, and design principles, as well as testing ecological validity (possibilities for generalisability). Data analysis often takes the form of retrospective comparisons of iterations.

Our research question is: What are reasonable starting points for including risk and risk assessment in physics?

What is risk?

There is a risk that the line- dancer…falls down and gets killed.

Suppose now that the line is only tensioned 1 m above the ground.

The likelihood of falling, may not have changed, but the consequence will be completely different if the person falls 1m than 100m!

Risk is the likelihood of an event involving danger that could occur, along with the severity of possible consequences.

Imagine there is a crowd under the line- dancer…

Figure 1: See https://commons.wikimedia.org/wiki/File%3ATightrope_walking.jpg
By Wiros from Barcelona, Spain [CC BY-SA 2.0 (http://creativecommons.org/licenses/by-sa/2.0)]
British Columbia Hazard, risk and vulnerablility Analysis tool kit 2004

Risk assessment in practice
Reports with matrices

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PROBABILITY			Risk level			
	Very big, will probably happen	4	Can be accepted (Ev Action Plan)	Action as soon as possible (Action)	Remedied immediately	Remedied immediately
	Large, can very well happen	3	Can be accepted (Ev Action Plan)	Action as soon as possible (Action)	Remedied immediately	Remedied immediately
	Small, but may happen	2	Can be accepted	Can be accepted	Action as soon as possible (Action)	Action as soon as possible (Action)
	Very small, Practically nonexistent	1	Can be accepted	Can be accepted	Can be accepted (Ev Action Plan)	Can be accepted (Ev Action Plan)
			1	2	3	4
			Mild	Sensible	Serious	Very serious
			CONSEQUENCE			

Methodology, Cycle 1

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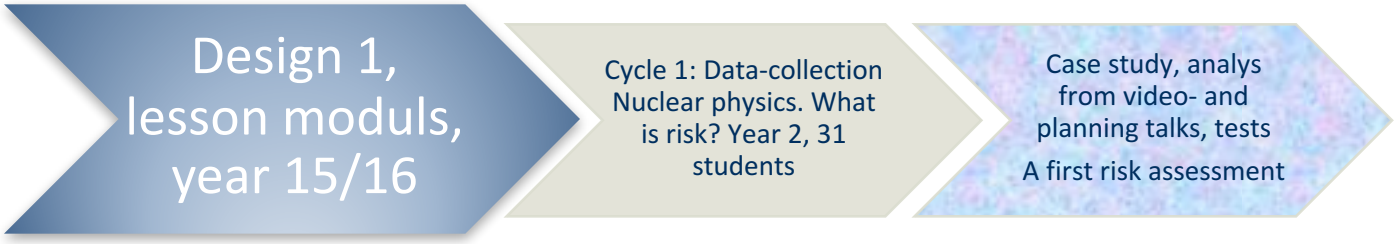
The first class was a second year technology class (1 girl, 30 boys, 31 total) who took a course in nuclear physics.

The five interventions :

1. An overview lesson
2. A group discussion lesson where students discuss open questions
3. A lesson where we introduce risk assessment, and do an exercise where students discuss in group and whole class how to conduct a risk assessment of irradiation of strawberries.
4. A theme assignment that students will study and present later. Student presentations of theme information.
5. Test with risk assessment data.

Result and analysis from Cycle1 – the group discussions



- Questions for a first group-dicussion:

  1. **What similarities and differences do you see with different radiation types?**

2. What risks and benefits do you see with different types of radiation
3. What types of radiation are we exposed to? When?
4. How do we protect ourselves from radiation?
5. Something you wonder about or want to know more about radiation?

Result Cycle 1 Discourse analysis with communicative moves – question 1, group 1

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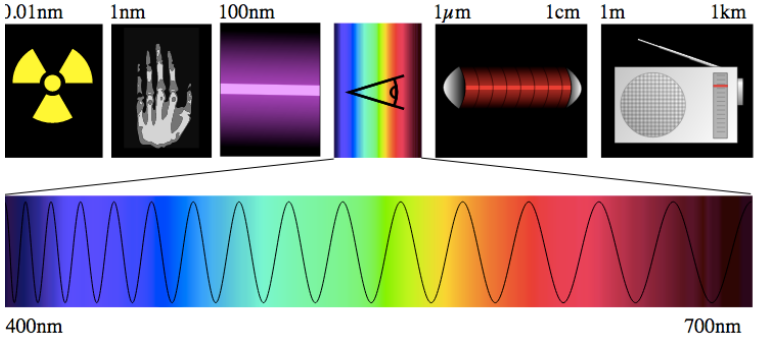
	Interaction (HOW?)	Content (WHAT?)
Linguistic level Talk as moves in the dialogue and in the content	Discursive Moves: **How do students speak to each other?** The conversation type is exploratory (exploratory) and clearly focused on deepening the knowledge.	Content Moves: **What content is in focus and what topics are discussed?** Similarities and differences between different radiation types are discussed.
Cognitive level Talk as actions and thoughts	Action moves: **How do students act when they make progress in the task?** Student 1 conducts the call, but perhaps a bit uncertain about how the function,conducting the conversation, but what he says is sometimes wrong.	Purposive moves: **What student purposes does the talk-sequence express?** The discussion is uncertain, and it is clear that radiation is not assimilated, even though terms such as wave motion, frequency, radiation and direction of motion figure are discussed.

Barnes &Todds, 1995; Mercer,& Littleton, 2009; Andersson & Enghag, 2017

Result Cycle 1
Summary from the group-discussions:



You said that all radiation was dangerous, is it?
All students: Noo.
Student 1: It is the ionizing radiation that is dangerous.

But risks and benefits then?
Student 4: Risks are that you can get cancer, and the benefit is to detect cancer through x-ray devices and so on.

Is there any more risk or benefit? Who has to do with radiation.
Student 6: Sunburn! Good or bad?
Student 6: Both and depending on how long it lasts. You get sunburned, and have a brown color on your skin, it depends on how long you are sunbathing. But so, it's going to be bad for a while.

Student 8: Another benefit is data communication, and wifi is also a radiation that we use every day.
Good, there is little everywhere.
Student 8: It's hard to talk about something that you do not know.
It's hard indeed to talk about what you do not know so much about.

Result Cycle 1: Introduce risk assessment, where students discuss irradiation of strawberries. Irradiation of strawberries - should we allow it?

Task in class:

What risk assessment do you do regarding irradiation of strawberries?

- Easier to sell for a long time
- Good that the strawberries are generally sterile, no health problems or the like for those who eat them
- Bad that we can not adapt to a natural flora of microorganisms, what does it mean in the long term?

Questions about whether radioactivity remains in the strawberries was picked up.

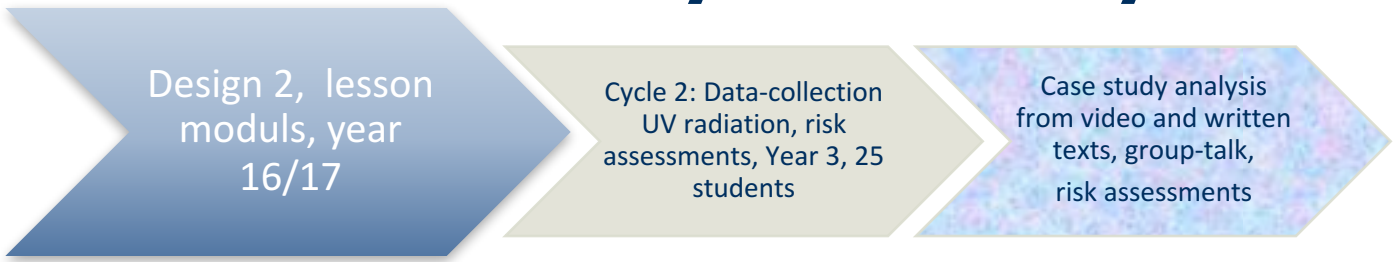
Methodology,Cycle 2

The class was from year 3 in upper-secondary science, 25 students in a course about Electromagnetic radiation. The first risk lesson was devoted to discussing risk related questions, and we introduced a risk matrix probability × consequence, and showed an example of such a risk matrix used in municipal planning.

The interventions included in the lessons were:

1. A lesson where we introduce risk assessment, and make an exercise students discuss in group how to conduct a risk assessment : *"Wi-Fi in the local busses and metro of Stockholm".*
2. **Student discuss in groups.**
3. Test with risk assessment data.

Result and analysis from Cycle 2



- 1: We started with risk-information and the students discussed the risk-assessment of ” “*Wi-Fi in the local busses and metro of Stockholm”.*
- **2: We had a discussion about five questions:**

  1 What is the risk and benefit of electromagnetic radiation?
  2 What risk and benefit do you see with x-rays?
  3 What risk and benefit do you see by solar radiation?
  4 How do you want to describe risk?
  5 What is important when making a risk assessment?
- 3:They finally made a test of the risk assessment in about sun-bathing..

Result Cycle 2 - Summary

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Electromagnetic radiation from the sun is dangerous, but because we have an atmosphere around the sun the radiation becomes "milder".

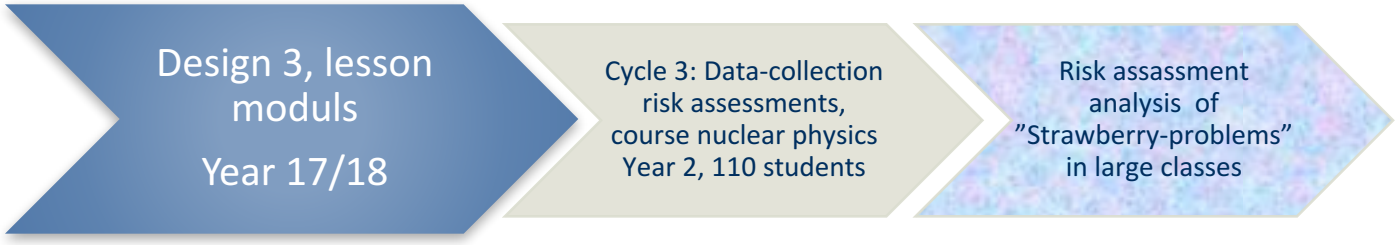
An ionizing radiation destroys the structure of the subject, where electrons are delivered and received. Therefore, non-ionizing radiation is not hazardous as it does not affect the substance in any way.

The risks of x-rays include getting cancer. The longer you exposure to the radiation, the greater the risk. The benefit of X-rays is that you can get a picture of the skeleton.

Solar radiation leads to an intake of vitamin D that is important to us humans. The risks of exposure to sun radiation include sunburn, skin cancer, for example. And the likelihood of being exposed to sunburn to become brown increases the amount of time you sunand if you are using sunscreen or not.

A risk is a likelihood that something will happen to a certain extent.

Methodology , Cycle 3



- The construction in cycle two resulted in improved argumentation of risk assessments. The change in design clearly shows that students needed an example as a template for expressing their own views.

- The outgoing design, to be carried out in autumn 2017, is to further change the design by adding different examples of how to write and discuss risk assessments and evaluate how this affects student arguments in their final risk assessment in a physics sample.

Discussion about the RQ

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What are reasonable starting points for including risk and risk assessment in physics?

- Literature: Decision-making in social issues with science content involving risks in the teaching

- Reasons: The underlying teaching problem -a fact-oriented approach - technology and science today cover so many socio-scientific dilemmas, -not so often completely safe to transfer (Christensen, 2009). By including risk assessments you can discuss interesting questions that concern the students as citizens. Risk assessment include physics components. Tests include problem-solving and risk.

- The students say: Interesting when the questions lack specific answers and when they have to think about issues relevant in everyday life.

- It was not difficult for students to take a stand in society-related issues, but the difficulty is that they need to be more accurate with the facts, enter references and types of information sources, and use an argumentation substantiating the statements they make.

- Necessary with interventions: 1) Discuss risk from examples in the course, 2) Let students work in groups 3) Let students be available in risk assessments construction (with fine literature that support them).

Thank you!

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