An integrated approach to inquiry based science learning in a secondary school:
Designing a colony on Mars

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Pilot-project Sint Jan: “Design a Colony on Mars”

Atheneum/gymnasium pupils design and create a “Colony on Mars” in their tto-Science class (1st year) at St. Janscollege (Hoensbroek, the Netherlands)
Who’s involved?

• Collaboration of various partners:
  – Sint Jan College, Hoensbroek, secondary school
  – Welten Institute – Center for Learning, Teaching and Technology
  – International partners within the weSPOT project
  – RCE Rhine-Meuse (OPEDUCA)
**What are we doing ?(1)**

<table>
<thead>
<tr>
<th>Learning design component</th>
<th>Mars Colony pilot</th>
<th>Maintained Science set-up</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task</strong></td>
<td>A real-world, complex and extensive task of designing a “Mars Colony”.</td>
<td>A real-world task, but with limited number, variety and complexity of perspectives and factors that need to be taken into account</td>
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<td><strong>Duration</strong></td>
<td>The Mars-project lasts the complete school year</td>
<td>One class task to be completed in 4 weeks.</td>
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<td><strong>Lesson schedule</strong></td>
<td>Four hours per week in one block combining several knowledge domains (respectively biology, chemistry, physics and technology).</td>
<td>A specific (e.g. physics) project takes a 1 hour lesson. Each knowledge domain is studied separately at a dedicated time.</td>
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What are we doing ?(2)

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<td><strong>Inquiry process to structure learning</strong></td>
<td>Learning activities are organized and structured according to the phases of the weSPOT inquiry based learning model.</td>
<td>Learning activities are organized in a project form, however the structuring and support of project activities is implicit.</td>
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<tr>
<td><strong>Teacher support</strong></td>
<td>An interdisciplinary team of 4 teachers (each from another ‘science’ discipline) provides feedback to students and analyzes and discuss student progress.</td>
<td>Teachers provide feedback individually and give support from the perspective of a single science domain perspective.</td>
</tr>
<tr>
<td><strong>External expertise by ‘out of school’ and ‘in school’ learning:</strong></td>
<td>Field and company trips are combined with lectures and counselling sessions of professionals within school</td>
<td>No external visits and expertise involved.</td>
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# What are we doing?

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| **Formative assessment - feed-up, feedback, feed-forward (Hattie & Timperley, 2007)** | • Feedback forms with rubrics and structured recommendations of peers and teachers for 21st century skills  
• Formative use of multiple-choice knowledge domain tests, including answer models                                                                 | Instruments supporting formative assessment of domain knowledge and 21st century skills are not available |
| **Summative assessment** | 21st century skills are taken into account for the final assessment of a student: 20% is domain knowledge test, 30% is portlog, 20% is a scale model and a presentation (PREZI), 10% is contribution to collaboration process (as assessed by contributions in environment and team members) and 10% is observation of teachers and (company) professionals. | Summative assessment was expressed 100% in domain knowledge. |
weSPOT Inquiry-Based Learning (IBL) Model

Protopsaltis et al. (2014)
http://inquiry.wespot.net/

Welcome

Sign in with weSPOT
Sign in with Google

Register for a weSPOT account
Reset your password

The weSPOT inquiry space lets you create, share and perform scientific inquiries either individually or in groups.
To learn more about what weSPOT offers to teachers, students and developers visit the project website.
Why are we doing this? (1)

- Increased attention for ‘generic’ complex skills, so-called 21st century skills
- Shift in thinking about complex skills as ‘enablers’ to ‘targets’ of school programs
- Importance recognized by teachers, but struggling with how to implement in daily classroom practice
Why are we doing this? (2)

- Faltering motivation of pupils at end of 1st year they entered secondary education
- Develop, implement and evaluate a learning design with which pupils:
  - Learn and apply domain knowledge (Science)
  - Develop a selection of 21st century skills
  - Are motivated to engage in Science
What happens in lessons?

• **How do pupils use weSPOT?**
  – E.g. Mindmapping, collecting and selecting data, communicating

• **What activities do they do in the project?**
  – E.g. Building, cooking, experimenting, discussing, listening, watch video-clips
What are the results? (1)

- Motivation (Deci & Ryan, 1985) still decreases in all groups
  - changes in “interest/enjoyment” and “readiness to invest effort” are significant
  - no significant changes in the perception of “task usefulness” are manifested.
  - no significant differences in motivation between groups
<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
<th>Frequency</th>
<th>Example(s)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>+ (77)</td>
<td>+) “I find the Mars project very interesting and captivating”; “I find it a nice and interesting topic to work on”; “Until now I liked the project”</td>
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<td></td>
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<td>- (50)</td>
<td>-) “To be honest the topic [Mars] doesn’t appeal to me, therefore I find it a bit boring”; “I find it a bit long-winded”</td>
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<td>+) “We have learned many things, especially to first search for information, then solve the problem and apply the knowledge”; “I have learned to look further than my own ideas.”; “we learn about oxygen and water, but we can also do things with our hands”; “The project is a valuable instructive experience”</td>
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<td>+) “I like it that we do different things, like working at the scale model and the planets”; “I like the project, as it contains many different things”; “one moment you are presenting, 10 minutes later you are building [on the scale model]”</td>
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<td>11</td>
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</table>
### What are the results? (3)

| Organisation | Referring to aspects of organisation (e.g. planning and (amount of) homework; scheduling; organization of instruction/support; use of (re)sources and tools etc. | 1 | 28 | -) “4 hours is too long”; “it is often not clear where to find what”; “it was a pity that we discussed everything at the last 5 minutes”; “sometimes I find the instruction around a task difficult to understand”; “I was sometimes confused about what I should do for homework”; “4 teachers (4 different answers)”; “lots of homework (and late posting of homework tasks)”; “after the 7th hour concentration diminishes”  
+ If these things are fixed [organized], science isn’t a big problem anymore  
| Technology | Referring to use of technology and (online) tools | - | 14 | -) “it contained too many log-in media”; “a lot of things, like weSPOT, are very difficult”; “many accounts”; “it is kind of expected that you have an Apple device”; “Many accounts”; “a disadvantage was that the iPads didn’t work” |
Conclusions

• Motivation still decreases in the pilot group
• Students in pilot setting appreciate the core of the learning design: diversity of learning tasks, real life contexts, combining research & design activities, learning and constructing knowledge actively themselves
• Critical remarks concern the chosen topic, organization and logistics and technology use
What’s next?

- Tackle planning and communication problems, complexity of set-up, multiple login-ins & diversity of electronic tools
- Continue collaboration (practitioners, researchers and developers) and iterative design approach
- Future evaluations: performance on knowledge domain tests, cognitive load, (system)usability and motivation
Thank you for your interest and attention!!
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Web portals
wespot-project.eu (project)
inquiry.wespot.net (environment)