STOCHASMOS: Redesigning a Web-based Platform for Inquiry-Oriented Teaching and Learning

Eleni A. Kyza
Cyprus University of Technology

Zacharias Zacharia
Learning in Science Group
University of Cyprus

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Presentation Overview

- Theoretical grounding of design
  - Inquiry learning
  - Collaboration
  - Reflection

- Overview of the STOCHASMOS platform
  - STOCHASMOS scaffolding
  - Teachers’ authoring system
  - Students’ learning environment

- Classroom-based enactments
Inquiry-based learning

“Scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world… Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations.”

[National Academy of Sciences, National Science Education Standards, 1996 Chapter 2, p.23.]
Inquiry-based learning

The STOCHASMOS learning environments support inquiry learning:

- Problem-based approach
- Driving question (to help focus)
- Authentic problems
  - Engaging (motivation)
  - Data-rich (complex)
  - Challenging (due to the nature of the problems)

Goal is explanation-driven inquiry
Inquiry-based learning

- The STOCHASMOS learning environments do not address all the different skills included in the inquiry definition we showed.

Data-rich, complex problems

Working in groups, students are asked to solve the problem and create evidence-based explanations.

- hypothesize
- predict
- observe
- interpret
- explain
- communicate
Inquiry-based learning

COLLABORATION

- hypothesize
- predict
- observe
- interpret
- explain
- communicate

REFLECTION
Inquiry-based learning

- Inquiry is a core process of science and a fundamental learning objective.

- However, it presents students with several challenges, such as planning, monitoring, and evaluating investigations, interpreting data in the light of hypotheses, and creating evidence-based explanations, including examining alternative interpretations of their data (e.g. Carey et al., 1989; Krajcik et al., 1998; Kuhn et al., 1988; C. Zimmerman, 2000, Sandoval, 2003, Kyza, 2004).

- There is a need to support learners in engaging with inquiry reflectively.
Reflective inquiry

- We define *reflection* as the ability to monitor and evaluate past and ongoing actions in order to help plan next steps.

- **Reflective inquiry** can be seen as a set of practices that help the inquirer adopt a systematic, critical, and evidence-based orientation to learning (Kyza & Edelson, 2003; Loh *et al.*, 1998).
STOCHASMOS

A web-based platform to support reflective inquiry
**The STOCHASMOS platform**

- Builds on prior technological design efforts, such as the Progress Portfolio and WISE
- Overall goal to scaffold students’ data-rich, self-regulated learning in science:
  - Making thinking visible.
  - Helping focus and organize investigations.
  - Augment opportunities for reflection through articulation.
  - Grounding articulation and reflection in the data.
  - Supporting the explanation building process, including reasoning about alternative explanations of the data.
  - Providing tools for communicating explanations.
STOCHASMSOS
A web-based platform to support reflective inquiry

An authoring environment for teachers

Teachers can:
- Create one or more learning environments
- Or adapt existing environments designed by others
- Customize or create new reflective templates for the WorkSpace
- Engage in embedded assessment (log, synchronous and asynchronous feedback mechanisms)
- Collaborate with other teachers

A learning environment for students

Inquiry Environment

Focus on:
- Reflection during inquiry
- Interpretation of primary data
- Evidence-based explanation building
- Student collaboration
- Peer feedback mechanisms
  - Synchronous communication: chat
  - Asynchronous communication: forum, Workspace templates sharing, peer feedback

Reflective Workspace

Focus on:
- Reflection during inquiry
- Interpretation of primary data
- Evidence-based explanation building
- Student collaboration
- Peer feedback mechanisms
  - Synchronous communication: chat
  - Asynchronous communication: forum, Workspace templates sharing, peer feedback
Students’ Inquiry Environments
Students’ WorkSpace templates
STOCHASMOS

Teachers’ Authoring Environment
STOCHASMOS investigates the role of new technologies in supporting middle-school students’ reflective inquiry practices in science and, in specific, the role of technology-based supports in scaffolding students’ reasoning with scientific data.

We have developed a web-based learning environment for supporting students’ scientific reasoning through scientifically authentic investigations with an embedded authoring tool. Teachers and other instructional designers can use this system to design their own web-based investigations with reflective supports. The STOCHASMOS environment is available in both the English and the Greek languages.

The research part of the project examined the interactions of the students with the web-based environment following a mixed-methods approach. We investigated the extent to which the reflective scaffolding supports the construction of students’ scientific explanations using quantitative as well as qualitative methods.

We are currently in the second development phase of the STOCHASMOS platform, in the context of the research and development program “Collaborative Inquiry Learning Environments” (project SYNERGASIA). This project is funded by the Cyprus Research Promotion Foundation.

Announcements

Talk to us during the following conferences:

» Kaleidoscope 2007 Symposium, November 26-27 2007, Berlin, Germany

» 17th Biennial Conference for Research on Learning and Instruction (EARLI), August 28-September 1, 2007, Budapest, Hungary.

» European Science Education Research Association meeting (ESERA), August 21-24, 2007, Berlin, Germany.

Help

How do I…

Information about…

Can’t find what you are looking for? Try searching the site or visit our sitemap.
Welcome to STOCHASMOS:
- To create or import a new inquiry environment select an option in the "Manage the Learning Environment" section. Upon the creation of a new environment, you can choose whether to include a Workspace, how to group students, and you will also be able to add or create new template pages.
- To add, delete, or modify your students, visit the section "Manage your students".

### Manage the Learning Environment

<table>
<thead>
<tr>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Το Φλομίγκο της Αλυκής Λάρνακας</td>
<td>Οι μαθητές θα διερευνήσουν το βάσιο των Φλομίγκο στην Αλυκή Λάρνακας και ταυτόχρονα μαθαίνουν για το οικοσύστημα της Αλυκής.</td>
</tr>
<tr>
<td>Οι Ντετέκτιβ</td>
<td>Η μικρή αυτή διερεύνηση έχει τους ακόλουθους σκοπούς: α) την εξοικείωση των μαθητών με το περιβάλλον του STOCHASMOY, β) την εξοικείωση με φυσικές φαινόμενα, στοιχεία για την επίδειξη των υποθέσεων/θεωριών, και πειστικές εξήγησης.</td>
</tr>
<tr>
<td>flamingo copy</td>
<td>elena</td>
</tr>
<tr>
<td>Flamingo copy (no Workspace)</td>
<td>See above</td>
</tr>
<tr>
<td>STOCHASMOS</td>
<td>STochasmos demo</td>
</tr>
<tr>
<td>Flamingo investigation</td>
<td>This is the English version of the Flamingo investigation. Please note that the content of the investigation is in Greek and that only the menus are in English.</td>
</tr>
<tr>
<td>The Detective Investigation</td>
<td>This investigation is a brief introductory activity to orient students to inquiry and the STOCHASMOS learning environment.</td>
</tr>
<tr>
<td>ff</td>
<td>f</td>
</tr>
<tr>
<td>Ντετέκτιβ (ΠΣ)</td>
<td>Περιβάλλον που δημιουργήθηκε για εξοικείωση των συμμετοχών στο πλαίσιο του προγράμματος ΠΣ το καλοκαίρι του 2006.</td>
</tr>
<tr>
<td>Οι Ντετέκτιβ</td>
<td>Διερεύνηση για το μύθημα ΕΠΑ660</td>
</tr>
<tr>
<td>Εγώ</td>
<td>περιγραφή του εαυτού μου</td>
</tr>
<tr>
<td>test</td>
<td>test</td>
</tr>
<tr>
<td>EN Flamingo</td>
<td>Flamingo investigation --partially translated to English</td>
</tr>
<tr>
<td>Βελτιστοποίηση - Αντί</td>
<td>Το περιβάλλον για διδασκαλία της μεθόδου της βελτιστοποίησης.</td>
</tr>
</tbody>
</table>
Manage project

- **Project**
  From here you can change the following general parameters of the Project: title, description, school, language, and topics. This where you can also activate and de-activate the Inquiry Environment or the students' Work Space.

- **Templates**
  - Here you have access to creating new templates for the students' Work Space or modify existing ones.
  - If you have not deactivated the students' Work Space, you will have to select which templates to use with each inquiry environment (if you have not yet created or imported an inquiry environment, the system will guide you in doing this).
  - You can create as many templates as you want to use in each inquiry environment.

- **Inquiry Environment**
  From here you can create or modify the inquiry environment: add or delete pages and modify the multimedia content of each page.

- **Add Group**
  Use this feature to group existing students, which you previously entered through the "Manage Students" section. Any groups created will only be valid for this inquiry environment.

- **Review**
  From here you can access the work of each group, can give feedback by inserting comments on the students' pages in the Work Space, or give a final score to each group.

- **Group Pairing**

- **Partnership**

- **Forum**
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- **Review**
  From here you can access the work of each group, can give feedback by inserting comments on the students' pages in the Work Space, or give a final score to each group.

- **Groups/Pages**

- **Partnership**

- **Forum**
Manage project

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- **Group Pairing**

- **Partnership**

- **Forum**
The Larnaca Salt Lake Flamingos

FEBRUARY 2003

Hello! My name is Erik Paraskevopoulos and I work for the Game Fund Service. A few days ago I received a phone call informing me that someone had found a dead Flamingo in the Larnaca Salt Lake. This incident might indicate a bigger problem.
STOCHASMOS WorkSpace templates
<table>
<thead>
<tr>
<th>Project</th>
<th>Teacher</th>
<th>Language</th>
<th>Project details</th>
<th>Inquiry environment</th>
<th>Actions</th>
</tr>
</thead>
</table>
| test        | Elena Kyza    | Greek    | Enable chat: YES  
Enable forum: YES  
Planned start date: 06/11/2007  
Subjects: Tâń 1  
Grades: Tâń 6 | View      | Invite |
| EN Flamingo | Elena Kyza    | English  | Enable chat: YES  
Enable forum: YES  
Planned start date: 20/11/2007  
Subjects: Tâń 1  
Grades: Tâń 6, Ελληνικά  
Εκπαίδευση | View      | Invite |
| flamingo    | Rociothea Xacilouca | Greek    | Enable chat: YES  
Enable forum: YES  
Planned start date: 01/11/2007  
Subjects: Tâń 1  
Grades: Tâń 6 | View      | Invite |
| new         | Antigoni Mios | English  | Enable chat: NO  
Enable forum: NO  
Planned start date: 05/11/2007  
Subjects: Tâń 7  
Grades: Tâń 7, Tâń 8 | View      | Invite |
| Phase II    | Mana Stephadoulo | English  | Enable chat: YES  
Enable forum: YES  
Planned start date: 13/11/2007  | View      | Invite |
Group Pairing

Groups available for pairing

The Detective Investigation
(Elena Kyza)
- Cosi1
- Cosi2
- Cosi3
- Cosi4
- Detectives
- Antigoni
- EK
- Claire
-...

The Detective Investigation
(Elena Kyza)
- Cosi1
- Cosi2
- Cosi3
- Cosi4
- Detectives
- Antigoni
- EK
- Claire
-...

Pairs

<table>
<thead>
<tr>
<th>Groups</th>
<th>Initiated by</th>
<th>Status</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frank (My project)</td>
<td>Elena Kyza</td>
<td>Accepted</td>
<td>delete</td>
</tr>
<tr>
<td>Angelique (My project)</td>
<td>Elena Kyza</td>
<td>Accepted</td>
<td>delete</td>
</tr>
</tbody>
</table>
Forum

What can I do here?

The forum is accessible by all students in a class. If two classes collaborate then students from both classes can share their questions and comments in this space. Please feel free to try things out to see how they work. [Please note that only teachers can delete posted contributions.]

<table>
<thead>
<tr>
<th>Title</th>
<th>Date</th>
<th>User</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>What other information do you need to solve the problem?</td>
<td>21/11/2007</td>
<td>Elena</td>
<td>comment</td>
</tr>
</tbody>
</table>
## Help text

- Select 'Review Student Work' to see the students' Work Space and give them feedback.
- You can give a final score for each group by selecting the pencil icon.

## Review

<table>
<thead>
<tr>
<th>{}</th>
<th>Review</th>
<th>Name</th>
<th>Pair</th>
<th>Chat</th>
<th>Review</th>
<th>Active</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Review</td>
<td>Cosil1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Review</td>
<td>Cosil2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Review</td>
<td>Cosil3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Review</td>
<td>Cosil4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Review</td>
<td>Detectives</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Review</td>
<td>Antigon</td>
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</tr>
<tr>
<td></td>
<td>Review</td>
<td>EK</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Review</td>
<td>Claire</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Review</td>
<td>Hans</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Review</td>
<td>Andreas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Review</td>
<td>S Schanze</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Review</td>
<td>Iris Tabak</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Review</td>
<td>KING'S</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Review</td>
<td>WSACY Det</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Review</td>
<td>Frank</td>
<td>Wouter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Review</td>
<td>Doris D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Review</td>
<td>ESERA1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
STOCHASMOS

Students’ Learning Environment
http://www.stochasmos.org/students
Members Login - Student

Username
Password
Login

Powered by NQcontent

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Hints on demand

Glossary

The Larnaca Salt Lake Flamingos

FEbruary 2003

Hello! My name is Erik Paraskevopoulos and I work for the Game Fund Service. A few days ago I received a phone call informing me that someone had found a dead Flamingo. Salt Lake might indicate a problem.

The Department of Fisheries needs your help; your role is to examine the data and explain why the Flamingo died. Find evidence to support your hypotheses and explain your case to the scientists at the Fisheries Department and the Game Fund Service. Make your explanation as convincing as possible.

To do this, you need to refer to your hypothesis, cite the data that supports it, and the data that can be...
Σύγκριση παραμέτρων

Graph 1

Category: Αλμυρότητα νερού Αλυκής
Table: Αλμυρότητα νερού (%)
Select Month Range: Jan 2000 - Dec 2004

Data provided by: Τμήμα Ανθρώπων και Φυσικών Επιστημών Ερευνών Κύπρου
Αλμυρότητα νερού (%)
Paste your data here and explain what they mean in the boxes that follow.

Look at the low salinity levels in 2003.

Which hypothesis do the data support or disconfirm?
Paste your data here and explain what they mean in the boxes that follow:

look at the low salinity levels in 2003

Which hypothesis do the data support or discount?

What do you mean by this comment?
Scaffolding reflective inquiry

Examples of scaffolds that can facilitate reflective inquiry:

**Doing the inquiry**
- Automating routine tasks to help students focus on the conceptual aspects of inquiry
- Data boxes for storing information
- Easy access to stored and interpreted data

**Reflecting on the inquiry**
- Data capture camera to support data evaluation
- Articulation prompts to support planning, monitoring, evaluating
- Annotations to allow free expression of ideas

**Collaborating**
- Making thinking visible
- Tasks, prompts and articulation boxes provide the basis for externalizing thinking to peers and teacher
- There is opportunity for ongoing synchronous and asynchronous feedback

**Embedded Assessment**
- Ongoing feedback opportunities
- Both from peers and teacher
- Chat/Forum/WorkSpace sharing
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STOCHASMOS

Classroom-based enactment & research
Enactments

The STOCHASMOS platform has been used with students of different ages, from elementary to high school students, and pre-service/in-service teachers.

We usually start with a brief training (e.g. Detectives investigation on STOCHASMOS) to:

- Help orient students to issues like data-rich inquiries, evidence-based explanations
- And get them acquainted with how to use the STOCHASMOS platform
Enactments

- We usually begin with an introduction to capture students’ attention and motivate their interest and existing knowledge
  - E.g. brainstorming session or a video
- By this point, students already know how to use the platform and know that they are expected to engage in this reflection-in-action process
  - Interpret data, capture evidence, and explain their thinking in the WorkSpace
Enactments

- Students work in groups and mostly independently.
- The teacher moves around and provides just-in-time feedback.
  - Teachers can also provide asynchronous feedback to groups (reviewing workspace pages, chat, forum).
- Groups engage in peer-review and peer-critiquing after the completion of certain stages in the project.
- Groups make final presentations of their work to each other & to their teacher.
Research questions

- Overall goal to examine the role of software-based reflective inquiry scaffolding in supporting student inquiry

- What is the role of the reflective inquiry scaffolding in the creation of evidence-based explanations?
  - Students’ ecosystem reasoning
  - What is the interaction between group ability, reflective inquiry scaffolding, and groups’ collaborative explanations?
Research Methodology

ACTIVITIES

• Students worked in dyads of high, low, and mixed ability.
• Lessons lasted for about 6 weeks and included an initial brainstorming activity, mid-investigation peer-reviews, and final class- and school-wide presentations.

DATA COLLECTION

• Pre and post tests examining students’ conceptual understanding and inquiry skills.
• Videotaped three groups’ interactions with the software, teachers, and peers.
• Logbook of the students’ use of the STOCHASMOS system.
• Each group’s computer-generated artifacts.

ANALYSIS

• Analysis of students’ final explanations.
• Statistical analyses of pre and post tests.
• Case studies of different ability groups as they work with the reflective WorkSpace or with PowerPoint.
Results

- An analysis of the students’ pre-post measurements indicated a statistically significant difference for the WorkSpace class, $t(26)=-4.492$, $p<.001$, and for the PowerPoint class $t(25)=-3.455$, $p<.005$.

- Cohen’s $d$ was 0.75, indicating a medium to large effect size of the intervention.

- Mean total explanation score was higher for the WorkSpace class, $M=11.2$, vs. $M=8.23$ for the PowerPoint class.
Results

- To examine the effect of the type of reflective scaffolding and ability grouping we used the Kruskal Wallis test.

- The analysis showed no differences between the three ability groupings in the workspace class, $x^2(2)=2.382$, $p>.05$.

- The analysis showed differences between the groups in the PowerPoint class, $x^2(2)=6.109$, $p<.05$.
  - Subsequent Mann Whitney U tests showed a significant difference between the groups in the HH and LL groupings ($U=.00$, $p<.05$), the HL and LL groupings ($U=1$, $p<.05$) but not between the HH and HL groupings ($U=4$, $p>.05$).
Results

WorkSpace
- Findings indicate that there was no statistically significant difference between HH, HL, and LL groups. This suggests that the different scaffolding may have helped the lower ability students bridge the gap between them and students of higher academic ability.

PowerPoint
- Findings indicate that the HH and HL groups outperformed the homogenous LL groups, but that there were no statistically significant differences between the homogenous high and mixed high-low ability groups.
- There were still differences between lower and higher ability groups.
Thank you.

http://www.stochasmos.org
info@stochasmos.org