

**COMPUTER BASED
LEARNING IN SCIENCE**

Conference Proceedings 2012

Learning Science in the Society of Computers

**Editors:
Roser Pintó
V́ctor L3pez
Cristina Simarro**

COMPUTER BASED
LEARNING IN SCIENCE

Proceedings

Learning Science in the Society of Computers

An International Conference
26th – 29th June 2012
Centre for Research in Science and Mathematics
Education (CRECIM)
Barcelona, Spain

Editors:
Roser Pintó
Víctor López
Cristina Simarro

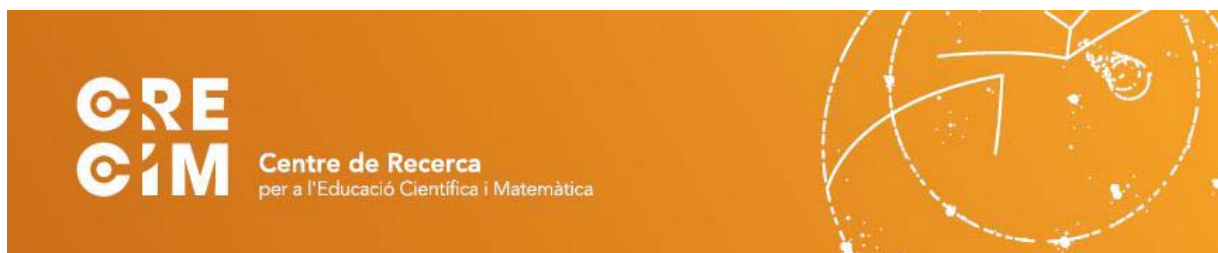
All Rights Reserved

Copyright 2012 © Centre for Research in Science and Mathematics (CRECIM)

No part of the material protected by this copyright notice may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, recording, or by an information storage or retrieval system, without written permission from the copyright owner.

ISBN 978-84-615-8954-8

Published by: CRECIM, Barcelona, Spain www.crecim.cat



PREFACE

Computer Based Learning in Science '12 (CBLIS '12) is the tenth in a series of international conferences that seek to provide a forum for researchers to present and discuss developments in computer technology aiming to assist learning in science and education. Papers have been accepted by authors working in science education at all levels together with papers by authors from other disciplines where the subject material offers transferability across disciplines.

The Proceedings contain the full text of the professionally refereed papers that were finally accepted for presentation at the conference and publication in the proceedings. The refereeing process operated in three stages:

62 abstracts were submitted for consideration – 1st refereeing process

55 authors were invited to present at the conference and submit draft manuscripts

33 papers were finally accepted for publication – 2nd refereeing process

The conference truly reflects international interest in computer based learning with 18 nations represented with a full coverage of all aspects of the topic.

A pleasing aspect and measurable success of the conference is the move towards jointly authored papers between contributors from different nations. These relationships have developed through collaboration between authors in previous conferences who see the benefits of sharing knowledge and expertise to the benefit of students worldwide.

The Conference Organizers would wish to see this develop further and are pleased to be the catalyst of good practice.

The Centre for Research in Science and Mathematics Education in Barcelona (Spain) is proud to host this conference.

To achieve the high level of presentation initially set at CBLIS '93 at the Technical University of Vienna, Austria and reinforced at the Silesian University of Opava, Czech Republic (CBLIS '95), De Montfort University, UK (CBLIS '97), University of Twente, Netherlands (CBLIS '99), Masaryk University, Brno, Czech Republic (CBLIS '01), University of Cyprus, Nicosia, Cyprus (CBLIS '03), University of Žilina (CBLIS '05), University of Crete (CBLIS '07) and the Computer Assisted Education and Information Technology Centre of Warsaw, Poland (CBLIS '10), it has been essential to maintain a strong paper review body. The Conference Chairperson and the Editors wish to express their gratitude for the support and encouragement provided by the International Scientific Committee:

Philip Barker (University of Teeside, UK)

Christian Buty (Université de Lyon 2, France)

Costas P. Constantinou (University of Cyprus, Cyprus)

Digna Couso Lagarón (CRECIM; UAB)

Frank Fursenko (University of South Australia, Australia)

Carme Grimalt Álvaro (CRECIM; UAB)

Rufina Gutiérrez Goncet (CRECIM; UAB)

Maria Isabel Hernández Rodríguez (CRECIM; UAB)

Jana Kapounova (University of Ostrava, Czech Republic)

Eleni A. Kyza (Cyprus University of Technology, Cyprus)

Thomas Lee Hench (Delaware County Community College, USA)

Víctor López Simó (CRECIM; UAB)

Isabel Martins (Universidade Federal do Rio de Janeiro, Brasil)

Kalogiannakis Michalis (University of Crete, Greece)

Roser Pintó Casulleras (CRECIM; UAB) Denise Whitelock (The Open University, UK)

Zacharias Zacharia, (University of Cyprus, Cyprus)

Most importantly, the Committee extends their thanks to all the authors who, in spite of busy workloads, have endeavored to meet the conference deadlines. The enthusiasm of the authors will guarantee the success of CBLIS '12 and will continue to stimulate both developments in the field and joint projects to explore ideas between participants.

Finally, we would like to express our sincere thanks to the organizing committee without whom the conference would not have been possible:

Organizing Committee

Alba Masagué Crespi (CRECIM; UAB)
Anna Artigas Roig (CRECIM; UAB)
Anna Garrido Espejo (CRECIM; UAB)
Cristina Simarro Rodríguez (CRECIM; UAB)
Jose L. Garrido Millán (CRECIM; UAB)
Raquel Rios Font (CRECIM; UAB)

Coordination Team

Roser Pintó Casulleras (CRECIM; UAB)
Víctor López Simó (CRECIM; UAB)

Our final word of thanks goes to all the conference participants who continue to contribute to the evolution of this community of researchers.

Roser Pintó¹, Víctor López² & Cristina Simarro³

CRECIM

Universitat Autònoma de Barcelona
Campus de Bellaterra, Edifici GL- 304

08193, Bellaterra, Barcelona, Spain

<http://www.crecim.cat>

Tel. +34 935814496

Email: ¹roser.pinto@uab.cat, ²victor.lopez@uab.cat, ³cristina.rodriiguez.simarro@uab.cat

NOTE FROM THE EDITORS

Since the first conference held in Vienna in 1993, the CBLIS has become an international forum to share and exchange ideas about teaching and learning Science with computers, to deepen the construction and development of new educational models and to elaborate contributions to both theoretical and practical in the field of computer-based Science teaching and learning. Throughout all the previous years, hundreds of researchers from dozens of universities from all continents have allowed to build around the CBLIS a consolidated network of people who have the philosophy to promote, through collaboration and exchange of experiences, the efficient use of computers in Science education. We understand that the computer science classroom has to become a tool to improve the current educational methods, bringing science to students and preparing them with better skills and abilities as future citizens of the knowledge society. Thus the CBLIS, throughout all these years, has forged their identity traits, addressing simultaneously science teaching and computers-based teaching. While there are several powerful international conferences devoted to science teaching and other dedicated to computers-based teaching, the conference CBLIS combines the two aspects as inseparable.

Furthermore, if in previous years the conference had titles such as *Integrating New Technologies*, now that reality has changed. These technologies are not new, and paradigmatically, the term NICTs has changed for ICTs. The computer and internet are not something futuristic, but they are already part of our lives (many children *digital-natives*). Additionally, the international conference CBLIS arrives to Barcelona at a time of global crisis and public debate on the role of innovation and research in the world. In the field of education - and specifically, the science education - we are at a point in the debate over the incorporation of educational technologies in classroom teaching and their use is more intense than ever, where we need to deeply reflecto on how to manage public investment to advance the digitization of the classrooms at all levels, and to find formulas for success that really involves improvements for teaching and learning science.

In the compilation of papers found in this document, many of these questions are arised, and through scientific rigor and educational innovation, right answers are sought, contributing to improve Science learning and teaching in the society of computers.

CONTENTS

TEACHERS AND ICT: PROFESSIONAL DEVELOPMENT AND TEACHERS' ROLE

J. Bernardino Lopes, J. Paulo Cravino, António Alberto Silva, Clara Viegas - <i>The role of teacher mediation using computer simulations in physical sciences to improve students' epistemic competences – a theoretical framework</i>	2
Ana Edite Cunha; Elisa Saraiva; Fernanda Dinis; Alcinda Anacleto; Carlos Pires; Artur Rosa; Manuel Augusto, Carla Aguiar Santos; J. Bernardino Lopes - <i>The influence of the teacher's research experience in his mediation of secondary school students learning using computer simulations</i>	11
Cândida Sarabando, José Paulo Cravino, Carla A. Santos - <i>Learning Physics concepts in basic school with computer simulations</i>	20
Alexandre Pinto, António Barbot, Clara Viegas, António A. Silva, Carla A. Santos, J. Bernardino Lopes - <i>Teacher education using computer simulations pre- and in-service primary school teacher training to teach science</i>	28
Hülya Aslan Efe, Medine Baran, Mukadder Baran - <i>Pre-service science teachers' expectations of computer courses</i>	37
Suzane El Hage, Christian Buty - <i>The effect of an ICT on the coherence of the teacher discourse: Case study of an electricity sequence at grade 12</i>	41
Rufina Gutierrez, Denise Whitelock - <i>Learning the concept of scientific model by means of analysing didactical scientific simulations</i>	48
Ana Pino Álvarez, Juan de Dios Jiménez Valladares, Ruth Jiménez Liso, Carlos Sampedro Villasán - <i>Experimenta, a science teacher training program in CBLIS</i>	58

VIRTUAL LEARNING ENVIRONMENTS AND E-ASSESSMENT

Thomas Lee Hench - <i>Applying diffusion of innovation theory to the evolution of online teaching</i>	68
Thomas Lee Hench - <i>Assessing metacognition via an online survey tool</i>	79
Jana Kapounová - <i>Evaluating each phase in the life cycle of elearning project</i>	89
Kateřina Kostolányová, Jana Šarmanová, Ondřej Takács - <i>Adaptive e-learning management</i>	97
Denise M. Whitelock, Lester H. Gilbert, Stylianos Hatzipanagos, Stuart Watt, Pei Zhang, Paul Gillary, Alejandra Recio Saucedo - <i>Supporting tutors with their feedback using openmentor in three different uk universities</i>	105

Zacharoula Smyrniou, E. Varypari, E. Tsouma - <i>Dialogical interactions concerning the scientific content through face to face and distance communication using web 2 tools ...</i>	117
Zacharoula Smyrniou, E. Tsouma - <i>Confronting challenges regarding global energy politics in a multiple platform of transmedia storytelling to improve English</i>	125
Zacharoula Smyrniou, R. Evripidou - <i>Learning to learn Science together</i>	132
Argyro Scholinaki, Nicos Papadouris, Constantinos P. Constantinou - <i>Design of an innovative on-line inquiry-based learning environment for "antibiotic resistance of bacteria"</i>	139
Elena Siakidou, Nicos Papadouris, Constantinos P. Constantinou - <i>A web-based learning environment on global warming for the development of argumentation skills</i>	146
COMPTUER TOOLS FOR SCIENCE TEACHING AND LEARNING: GAMES, MUTLMEDIA, SIMULATIONS, MBL AND VIRTUAL LABS	
Carne Artigas, Jordi Cuadros, Fina Guitart - <i>Contextualized virtual lab-based activities for chemistry education in secondary school</i>	156
Rosiane da Silva Rodrigues, Marlise Geller - <i>Mathematic education for the deaf: investigating the use of Jclíc for the 1st grade in elementary school</i>	164
Renato P. dos Santos - <i>Second life as a platform for physics simulations and microworlds: an evaluation</i>	173
Fina Guitart, Montserrat Tortosa - <i>How to implement a better use of mbl in the science classroom?</i>	181
Christian Buty, Claire Wajeman - <i>Comparison of traditional and computer-based practical activities in physics at the university; the perspectives of modelling and task analysis</i>	187
Raimund Girwidz - <i>Multimedia learning in Physics</i>	197
Denise Whitelock, Roser Pintó, Rufina Gutierrez - <i>A roadmap to employ new technologies to teach science to chronically ill children</i>	214
Mary Ulicsak - <i>Computers games as tools to teach science in the classroom: when is this a good idea?</i>	226
Jiří Šibor, Irena Plucková, Eva Trnová, Josef Trna - <i>Interactive multimedia textbook – A way to increasing learners´ interest in chemistry classes</i>	233
Italo Testa, Giovanni Chiefari, Elena Sassi - <i>Integrating scientific inquiry and technological design activities using microcomputer-based laboratories</i>	245

Nicholas Zaranis - <i>The use of ICT in preschool education for geometry teaching</i>	256
Dimitrios Papachristos, Nikitas Nikitakos, Michail Kalogiannakis, Konstantinos Alafodimos - <i>Gaze tracking method in marine education for satisfaction analysis</i>	263
Michail Kalogiannakis, Charikleia Rekoumi, Ekaterini Antipa - <i>Planning educational activities for natural sciences using ict tools: teaching volcanoes in early childhood</i>	272
Michail Kalogiannakis, Charikleia Rekoumi, Konstantinos Chatzipapas - <i>Playing on the journey of sound: a teaching proposal for children in early childhood</i>	279
Georgios Olympiou, Zacharias C. Zacharia, Ton de Jong - <i>Combining concrete and abstract visual representations in a simulation-based learning environment: effects on students' learning in physics</i>	286
AUTHORS INDEX	294

DIALOGICAL INTERACTIONS CONCERNING THE SCIENTIFIC CONTENT THROUGH FACE TO FACE AND DISTANCE COMMUNICATION USING WEB 2 TOOLS

Z. Smyrniou, E. Varypari, E. Tsouma

ABSTRACT

The existing literature points to an array of issues related to science inquiry and dialogical interactions between students trying to resolve a scientific problem. The objective of this paper is the study of how students interact face to face as well as distant in the modern shared screen of the Metafora Platform when using Web2.0 tools (Planning Tool, Argumentation Tool) in which students learn how to learn together, argue and construct plans to resolve problems concerning scientific matters. Those tools include visual language based on the theoretical structure of inquiry, as well as based on the theoretical structure of constructionism and of argumentation theory as part of the Metafora Platform. This study contributes to the knowledge basis regarding the communication and the cooperation between students in an attempt to resolve two common challenges. The results of this study demonstrate that dialogical interactions promoted effectively the abilities of science inquiry.

KEYWORDS

Dialogical interactions; Modern learning platform; Planning tool; Argumentation tool (LASAD); Physical sciences

INTRODUCTION

Scientists are interested in the role dialogical interactions play in learning new scientific concepts as well as in the acquisition of skills. For the present pilot study of the Physics challenge-based scenario, 12 students will, work in subgroups of two, each one on their own computer. The communication among the subgroups will be synchronous through the Metafora platform. The factors that influence learning through collaborative activities are numerous: personality of students, relations, ability to express their opinion and support it etc. (Dillenbourg, Baker, Blaye & O'Malley, 1996). These factors, however, are numerous and interact with each other in such a way that one can not ascertain a-priori results.

In particular, we are interested in the way Greek students of the the 8th class (13-14 years old) interact when using two pedagogical tools (Planning Tool, Argumentation Tool) which include visual language based on the theoretical structure of inquiry as far as the first is concerned, as well as based on the theoretical structure of constructionism and of argumentation theory regarding the second. The mission of the two subgroups is coping with a common challenge (Main Challenge) in the 3D juggler microworld (Figure 1), which is interactive educational software of physics. By adjusting the various variables of this software such as Sphere mass, Sphere Size, Shot Altitude, Shot Azimuth, Gravity pull and Initial velocity (Power), students have the opportunity to study the phenomenon of "Shot". In order to communicate, they use the Argumentation tool (LASAD), which includes cards such as "Comment", "Microworld idea", "Microworld Action", "Sharing thoughts", etc. In addition, they use the Planning tool for the construction of the joint plan, that includes cards such as "Find hypothesis", "Construct a model", "Conclude", etc.

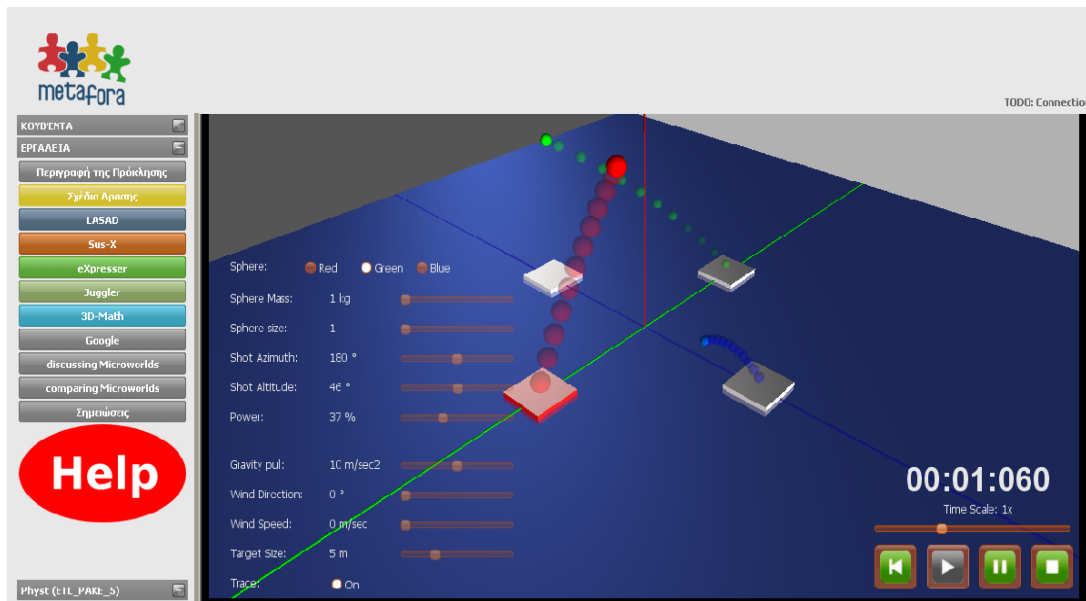


Figure 1. 3D Juggler Microworld

THEORETICAL FRAMEWORK

Inquiry based learning is the main point concerning LASAD and Planning tool. What needs to be highlighted is the modern theoretical framework that includes the scientific process or exploratory learning and attempts to describe the complex processes of the learning process but also the skills to be acquired by students. There are various forms of inquiry (Zacharia, 2007), including: reflective enquiry (Kyza & Edelson, 2003), scientific inquiry-based learning context (de Jong, 2006), dialogical processes of enquiry (Grandy & Duschl, 2007). Five different approaches describe inquiry-based learning in Metafora Learning (Wegerif & Yang, 2011): personal inquiry framework (Scanlon et al. (In press), generic inquiry cycle (Shimoda et al., 2002), case-, problem-, and project-based inquiry learning (Schwartz et al., 1999), constructivist inquiry cycle (Llewelyn, 2002) and progressive inquiry (Hakkarainen, 2010). Challenge based, which we have already mentioned, is embedded in inquiry-based learning and so does modelling as a process of thinking, reasoning and expression (Smyrniou & Dimitracopoulou, 2007 Petridou et al., 2009).

Both challenge and modelling are related to the actions of students in the domain tool of Metafora, the Physics microworld, 3D juggler. In this environment, students will construct their model in an attempt to find the solution to the challenge. Their discussions will change from general into specific. To a smaller or greater extent they will follow the constructionist ontology (Yiannoutsou et al., 2011). There, they will select the objects, their attributes, and relationships among them. They will construct and deconstruct their microworlds, they will test them through visual feedback (Kynigos, 2007).

Three factors seem to affect the solution of a problem when students work in teams (in the context of collaborative learning): their prior knowledge, the roles they adopt and the information they exchange. (Dillenbourg, Baker, Blaye & O'Malley, 1996). These three factors seem to determine their dialogical interactions and scientists have proposed cognitive forms of dialogue in order to analyze the dialogical-verbal students' interactions (Kneser & Ploetzner, 2001). In Metafora Learning, the use of the Visual Language is a main factor and strongly suggested (Wegerif & Yang, 2011).

In Physics, the knowledge of the scientific content students acquire is the factor we are mainly interested in (Psillos & Niedderer, 2002). It is known from relevant research that the creation of scientific meanings starts from the intuitions (Anastopoulou et al., 2011), the initial representations of

students (Driver, 1989), the phenomenological descriptions, the descriptions of actions or events perceived as scientific concepts and relationships between concepts (Smyrnaïou & Weil-Barais, 2005).

During the pilot phase there will not be any guidance from the Metafora system but there was a short guidance by a teacher or researcher. This may be deemed necessary at a later stage. Individual behavior and group behavior need to be distinguished in order to understand collaborative learning experience, since different collaboration styles are adopted by different individuals throughout the collaborative project. Content analysis is suggested to be conducted concerning the individual discourse to characterize the topics and key words of the messages and trace individual learning trajectories in the group (Wegerif & Yang 2011).

According to the theory of inquiry, of constructionism as well as of dialogical interactions, we created a framework to analyze our experimental data.

DESCRIPTION OF THE STUDY

In this study we are interested in students' interactions in their attempt to resolve the scientific problem. In particular, we examine their discussions when trying to construct a plan of resolving the problem and when trying to explain with arguments the entire procedure to their classmates, not only to the same subgroup through face to face communication, but also to their classmates of the other subgroup by distance communicating through the shared screen of the platform. The previous dimensions become more interesting when students use tools, like planning tool, argumentation tool and constructionist tool to resolve the challenge in Metafora Learning. Within this conceptualization and implementation, the present study examined how school students designed a planning process or an inquiry process, construct a model to answer the challenge (or challenge-based questions) and argument on these using the Metafora system. Another important consideration relates to the fact that LASAD and Planning tool include cards that must be completed.

This challenge-based study explores three research questions:

- What is the role of dialogical interactions in creating scientific meanings through Planning tool and Argumentation tool?
- What are the characteristics of the dialogues emerged from the use of the tools?
- What are the roles of the tools to stimulate and sustain the dialogues?

Taking into consideration the theoretical framework presented before, we will present the factors based on which we will analyze the plans that will be designed by each subgroup in the pilot study. Their discussions will be analyzed according to five dimensions as presented below: inquiry, constructionism, computer-supported collaborative learning, scientific content, argumentation.

RESEARCH METHOD-PROCEDURE

Students were divided in three groups of four, each of which was divided in subgroups of two in order to cope with a common challenge related to the "Shots". In order students to be familiarized with the three tools: LASAD, Planning tool, 3d Juggler Microworld of the Metafora Platform, they were asked to navigate to them in order to understand their functionalities. Then, they were given a warm-up challenge, as presented below: "Keeping the blue and the green balls still, shoot the red ball vertically upwards".

The two subgroups tried to resolve together the challenge, discussing through LASAD, stating their ideas and explaining their moves. They also had to construct a common plan in Planning Tool with the moves that led to the solution of the challenge. The two subgroups tried to resolve together the challenge, discussing through LASAD, stating their ideas and explaining their moves. They also had to construct a common plan in Planning Tool with the moves that led to the solution of the challenge.

Once familiarized with the three tools in the stage of the warm-up and figured out which sliders regulate and how they do so, they followed the same procedure to resolve the main challenge, as presented below: “The red ball should hit the blue ball’s base”.

In this study we focused in one group, because it was pilot and we were interested in the detail of what was told as well as done, in order to draw conclusions for the design of the main study which will be carried out in the next phase.

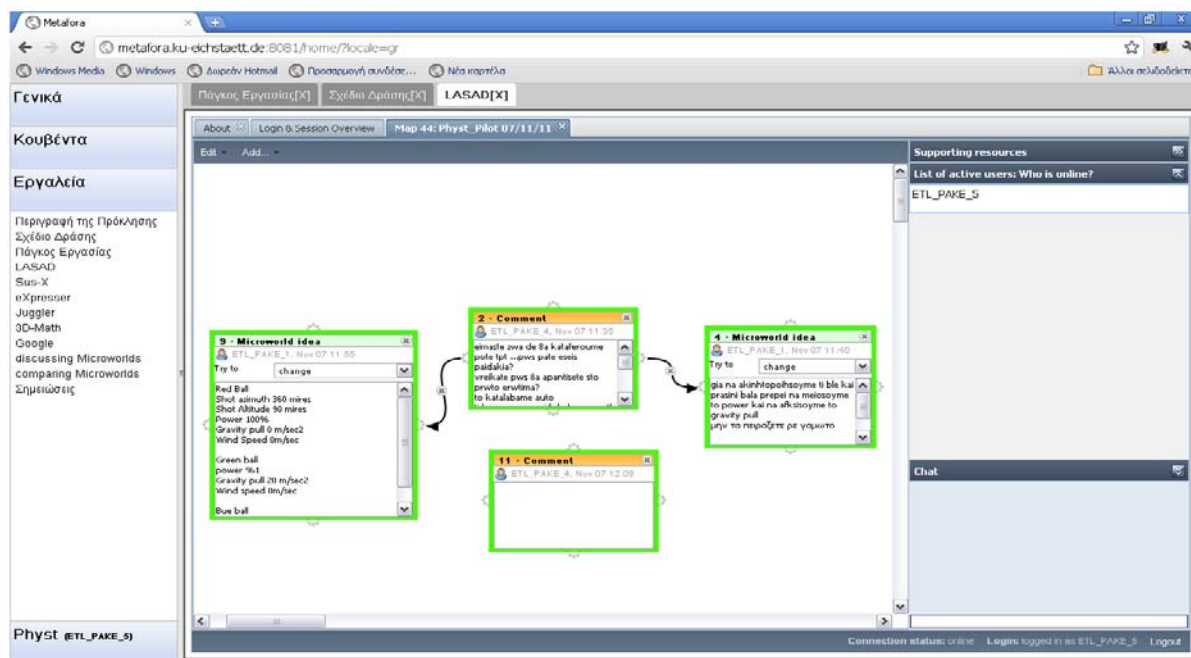


Figure 2. LASAD

RESULTS

The analysis of the student’s dialogues reveals that during the warm-up the two subgroups, communicated with each other through LASAD in order to resolve the challenge after exploring juggler and after deciding how to resolve the challenge. Then, in order to construct the joint plan with the moves that led to the solution of the challenge, students used Planning tool. The dialogue that takes place in LASAD relates to their moves in the Planning tool. What is more important to highlight in this point is that LASAD was necessary for the communication of the subgroups since there was no other means of communication (students were far apart). It is also important to note here that even though subgroup B worked creative with no problems, subgroup A had many disagreements and was more competitive in the whole challenge, since it does not provide any answer to the other subgroup.

At the same time subgroup A was unwilling to share its ideas, in spite of starting the discussion. On the other hand, subgroup B willingly shared its ideas as well as information concerning the successful changes of the variable values when solving the challenge. It is furthermore obvious that subgroup A was constantly in an attempt to take a leading role in constructing the plan, assuming that they work better than the other subgroup. Overall, subgroups manage to construct a joint plan in the Planning tool with the moves that led to the solution of the challenge. It is obvious, though, that subgroups argue about the fact that each one of them changes or puts in row the cards of the other subgroup.

At the same time the analysis also showed that in the Planning tool subgroups tried to record their assumptions regarding the way they could resolve the challenge. Their cooperation seems really well, since they complement each other in their attempt to create a joint plan. It furthermore becomes obvious

that the scientific method was properly approached as illustrated by the cards chosen and the order in which they were placed in the Planning tool (Figure 3).

As also evidenced subgroups confronted a problem of understanding in the middle of the process, so the students of subgroup B deleted all the cards from the surface of the Planning tool, assuming that subgroup A deleted some of the cards that they had written. However, this problem was overcome and the two subgroups construct the joint plan.

Data indicate that overall the cooperation between the two subgroups is evolving well, since they discuss on the alterations of the values in the variables. Even though subgroup A seems initially to question the values that the other subgroup gave to some variables, subgroup B does not disagree but argues that the values they also gave to the variables, can resolve the challenge. Subgroup B seeks cooperation since it requests to contribute in the construction of that plan, with ideas about what they could note on each card.

The analysis also revealed that, the two subgroups record their assumptions concerning the solution of the challenge. Based on the observations, even though initially, the cooperation of the two subgroups was not successful, since they chose cards with the same title and they note different data, later they seem to cooperate pretty well. Subgroup A corrects the content of some cards afterwards with the participation of both subgroups, they construct the joint plan.

It is further indicated that according to the choices students made regarding the cards and their order, they have approached correctly the scientific method. Overall, the cards of the Planning tool contributed to the construction of the joint plan, while the dialogues were not stimulated and sustained by the wrong choices regarding the cards of LASAD.

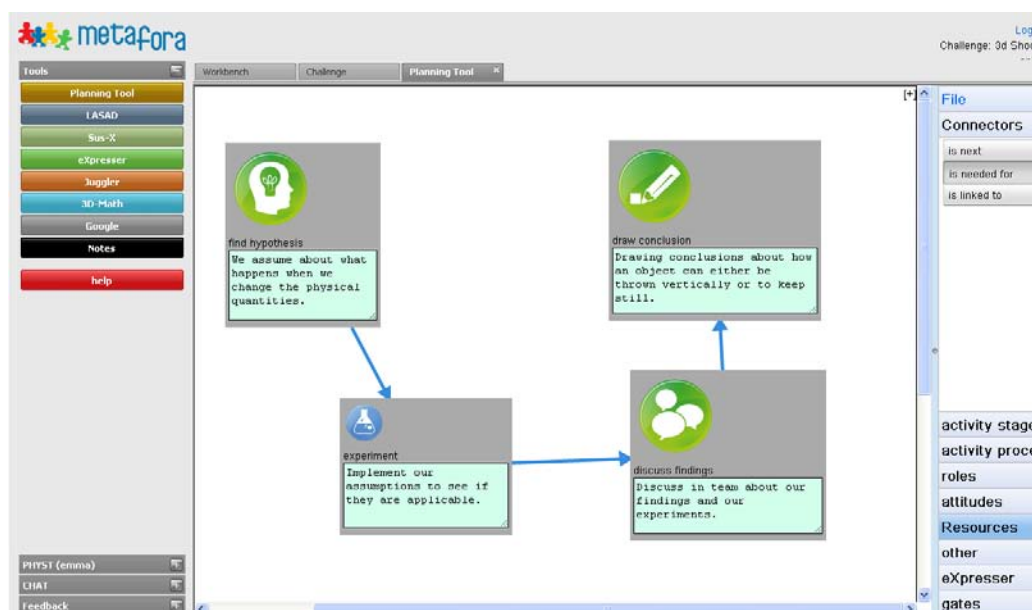


Figure 3. Planning Tool

CONCLUSIONS

The results of the analysis suggest that students became able to plan procedures for investigation, build models using technology-based learning environment, record results and draw conclusions. The largest gains were obtained for the skills of planning, modeling and drawing a conclusion.

Concretely, even though in the stage of the warm-up, LASAD was not exploited effectively by the two subgroups, in the stage of the main challenge, it was used more, since both subgroups contributed with

their ideas in order to resolve the common challenge by expressing their ideas and thoughts. However, this implication did not happen in the stage of constructing the plan, since students did not use LASAD as means to communicate.

More specifically, LASAD contributed to the solution of the challenge, since subgroups could exchange of views and for constructing a common plan in the Planning Tool. Another important implication is that LASAD was exploited so as to ask questions, express agreement or disagreement and report the values that were given to the variables to resolve the challenge.

Additionally the students of our study used Planning Tool exclusively for the construction of the joint plan by in which their moves were recorded regarding the way through which they reached the solution of the challenge.

Overall we contend even though the two subgroups in the initial stage did not cooperate effectively, in the later stage they seem to cooperate well. We also argue that they have approached properly the scientific method taking into account the cards students chose. In addition planning tool led subgroups to the creation of scientific meanings. This conclusion is not apparent, though, for LASAD. As a final conclusion of this study, inquiry-based and modeling-based instruction promoted effectively the interactions between the students.

ACKNOWLEDGEMENTS

Metafora: “Learning to learn together: A visual language for social orchestration of educational activities”. EC - FP7-ICT-2009-5, Technology-enhanced Learning, No. 257872.

REFERENCES

Anastopoulou, M., Smyrniou, Z. and Kynigos, C., (2011). Bringing intuitions of natural and virtual interactions into conflict: the POLYMECHANON experience. Proceedings of the 9th International Gesture Workshop Gesture in Embodied Communication and Human-Computer Interaction, 68-71.

De Jong, T., (2006). Scaffolds for scientific discovery learning. Handling complexity in learning environments, Theory and research, 107–128.

Dillenbourg, P. Baker, M., Blaye, A and O’Malley, C., (1996). The evolution of research on collaborative learning, Learning in humans and machines: Towards an interdisciplinary learning science, Oxford: Elsevier Science, 189-211.

Driver, R., (1989). Students' Conceptions and the Learning of Science, International Journal of Science Education, 11, 481-490.

Grandy, R. & Duschl, R., (2007). Reconsidering the Character and Role of Inquiry in School Science: Analysis of a Conference, Science & Education, 16(1), 141-166

Hakkarainen, K., (2010). Learning Communities in the Classroom, International Handbook of Psychology in Education: 177-225.

Kneser, C. & Ploetzner, R., (2001). Collaboration on the basis of complementary domain knowledge: observed dialogue structures and their relation to learning success, Learning and Instruction, 11, 53-83.

Kynigos, C., (2007). Half-Baked Logo Microworlds as Boundary Objects in Integrated Design, Informatics in Education, 6 (2), 335–359.

Kyza, E. A., and Edelson, D. C., (2003). Reflective inquiry: What it is and how can software scaffolds help. Paper presented at the Annual Meeting of the American Educational Research Association: Chicago, IL.

Llewellyn, D., (2002). *Inquire within: Implementing inquiry-based science standards*, Thousand Oaks, CA: Corwin Press.

Petridou, E., Psillos, D., Xatzikraniotis, E., and Viiri, J., (2009). Design and development of a microscopic model for polarization, *Physics Education*, 44 (6), 589–598.

Psillos, D. and Niedderer, H., (2002). *Teaching and learning in the science laboratory*, Kluwer Academic Publishers.

Scanlon, E., Anastopoulou, S., Kerawalla, L. and Mulholland, P., (in press). How technology resources can be used to represent personal inquiry and support students' understanding of it across contexts, *Journal of Computer Assisted Learning*. DOI: 10.1111/j.1365-2729.2011.00414.x

Shimoda, T.A., White, B.Y. and Frederiksen, J.R., (2002). Student goal orientation in learning inquiry skills with modifiable software advisors, *Science Education*, 86 (2), 244 – 263.

Schwartz, D., Lin, X., Brophy, S., and Bransford, J., (1999). Toward the development of flexibility adaptive instructional design, *Instructional-design theories and models: A new paradigm of instructional theory*, Mahwah, NJ: Erlbaum, 2, 183–214.

Smyrniou, Z. and Dimitracopoulou, A., (2007). Inquiry learning using a technology-based learning environment. *Proceedings of 8th International Conference on Computer Based Learning (CBLIS)*, 90-100.

Smyrniou, Z. and Weil-Barais, A., (2005). Évaluation cognitive d'un logiciel de modélisation auprès d'élèves de collège, *Didaskalia*, 27, 133-149.

Wegerif, R. and Yang, Y., (2011). *Visual Language for Learning Processes*, Metafora Deliverable D2.1.

Yiannoutou, N., Daskolia, M., Smyrniou, Z., Moustaki, F., Kynigos, C., (2011). Introducing planning in socio-constructionist activities in Environmental Education, Maths and Physics. Paper presented at the 14th Biennial EARLI Conference for Research on Learning and Instruction, Education for a Global Networked Society, Exeter, United Kingdom.

Zacharia, Z. C., (2007). Comparing and combining real and virtual experimentation: An effort to enhance students' conceptual understanding of electric circuits, *Journal of Computer Assisted Learning* 23(2), 120–132.

Z. Smyrniou
Lecturer
Didactic Science
Educational Technology Lab, School of Philosophy
Department of Pedagogy
National and Kapodistrian University of Athens
Panepistimioupoli, Ilissia, 15784
Greece
Email: zsmyrniou@ppp.uoa.gr

E. Varypati
Student
Educational Technology Lab, School of Philosophy
Department of Pedagogy
National and Kapodistrian University of Athens
Panepistimioupoli, Ilissia, 15784
Greece
Email: emvaripati@yahoo.gr

E. Tsouma
Student
Educational Technology Lab, School of Philosophy
Department of Pedagogy
National and Kapodistrian University of Athens
Panepistimioupoli, Ilissia, 15784
Greece
Email: tsouma_e@hotmail.com