Developing a Planning and Reflection tool to Support Learning to Learn Together (L2L2)

Abstract: One key feature of knowledge work is collaborative shared enquiry and problem solving mediated by electronic networks. We report on the development of an ICT tool to support learning how to learn together (L2L2) as part of an EC funded project called 'Metafora' (FP7-ICT-2009.4.2/257872**)**. Through literature review we isolated some key features of L2L2. We turned these into icons within an ICT environment to support planning and reflection of inquiries stimulated by real-world challenges. Design-based research in secondary schools in the UK, Spain, Greece and Israel over one year developed and evaluated this tool and found that it can increase awareness of the key aspects of learning together and so promote a transferable competence. Specifying the nature of L2L2 is also a significant contribution to the debate. These findings may contribute to the development of tools to support more web-mediated collaborative learning.

Keywords: Learning to learning together (L2L2), Computer Supported Collaborative Learning (CSCL), Knowledge-age skills, Technology Enhanced Learning (TEL), Secondary Education, Inquiry-based science learning (IBSE)

1. Introduction

When, in April 2010 an explosion in the Gulf of Mexico caused a flow of oil, BP responded by assembling a team of experts to find a solution. This team was not co-located and so they had to work together sharing ideas and co-constructing plans of action supported by web-mediated communication tools. Distributed teams of experts working together to solve problems and inquire into issues are increasingly common in the knowledge economy. Computer supported collaborative teamwork of this kind is not only a response to time-sensitive crises but it is also the main means by which new knowledge is constructed in the sciences. However, current education systems do little to equip children and young people with the complex competence of problem solving and learning together with others online. In the case of the 2010 oil spill the team of experts failed to come up with a successful solution until the oil had flowed for three months doing great damage to the environment. A lack of technical knowledge may have contributed to this failure but it is also possible that a lack of knowledge about and experience of learning together effectively may have contributed to this delay. There has been some research on ways to teach for learning how to learn, which is often referred to as the most important knowledge age skill as it equips people to adapt flexibly in a time of rapid change. However there has been little research on how to teach for the skills involved in learning how to learn together, which is possibly even more important for surviving and thriving in the knowledge age since most knowledge work is conducted by teams and not by individuals.

The Metafora project [1] funded by the EC Framework 7 ICT program has, as one of its aims, specifying the nature of learning to learn together (L2L2) so as to be able to model this in a computer-based tool. Computer-supported learning in groups is a complex competence that requires that all the group members are able to coordinate, regulate and plan the learning task balancing issues of individual ability, motivation and expectations through constant dialogue. When starting to work on a collective task, the group need to be able to show distributed leadership, motivate one another, ensure engagement (or find ways to respond when this does not occur), reflect on the quality of the work delivered, deal with (constructive) criticism, reflect on the overall direction of their work (and consult outside experts if needed), and make sure all group members are doing what is expected. Towards the end of the task they need to be able to wrap things up, judge if the learning goals are reached, peer review their work and submit it in time. A web-based Metafora learning environment is being developed that includes a planning and reflection tool that implements an understanding of the key features of learning together in a visual language (a language made up of manipulable visual icons) intended to facilitate greater awareness of the process of learning together. This planning and reflection tool is integrated with an online dialogue support system using a dynamic concept mapping tool called LASAD [2] and various microworlds [3] which support constructionist learning in mathematical, scientific and socio-environmental domains. This paper focuses on the development of a planning and reflection tool using a visual language representing the key components and features required for L2L2.

The Metafora system is currently being developed with the help of secondary school science, mathematics and environmental education teachers in the UK, Spain, Greece and Israel to support collaborative inquiry-based learning in science and mathematics and environmental education stimulated by complex real-world questions. However we think that it has the potential to support learning beyond the classroom. Social networking sites such as Facebook have proved popular but are not equipped with tools that can help groups engage in inquiry-based learning together. The Metafora planning tool is web-based and could support any group in an enquiry into any topic.

1. Objectives and Research Questions

In the work described we had two main objectives,

to understand and specify the component parts and features of the complex competence of L2L2 and

to embody this understanding in a visual language representing the key components and features of learning together such that using this language to plan and reflect on collaborative inquiry based learning would teach children and young people the complex transferable competence of L2L2.

This project was conducted as design-based research in which our overarching research question at each iteration was:

Does the visual language help students learn how to learn and how to think and work together? If so, how?

Sub questions were:

1): How is the visual language used by groups of students to plan their learning around the challenge?

2): Does the use of the tools improve their awareness of the key variables and stages of doing a science inquiry, solving a maths problem, addressing an environmental or sustainability issue while they are constructing or de-contructing a related microworld? If so, in what ways? To what extent? If not, why not?

2. Methodology

We began with a literature review of all approaches to teaching the inquiry process. This led to lists of components and features that we synthesised into a single set of terms. This set of terms was then converted into a set of icons initially implemented in laminated paper cards and then implemented into a software set of manipulable items. This visual language was used as a basis for design-based research (DBR) in three main stages or iterations. Each iteration consisted of design workshops with teachers and students in the UK, Spain, Greece and Israel. After each iteration the data were analysed and the visual language was refined and developed on the basis of the findings. The research took place over one year, from September 2010 to September 2011.

Design workshops were our main method of empirical data collection. The exact format of the workshop varied across the partners but all involved giving a group of between 4 and 6 teachers and/or students a complex challenge to solve and asking them to plan together how they would approach solving this challenge. For example in Lleida in Spain 5 students age 17 were introduced to the real-world problem that the local river Segre has pollution levels beyond those that are acceptable. Using a set of laminated cards implementing our initial iteration of the visual language they then planned together how to set about first understand and then solving this problem. Other inquiries were conducted with similar small groups in schools in the UK, Greece and Israel.

In each design workshop we video recorded the group working with the cards. We then interviewed the participants in an open-ended way about their use of the cards. We then analysed the data to explore the impact of the visual language using interpretative discourse analysis influenced by socio-cultural discourse analysis and by conversation analysis [4,5]. When possible we also used Key Event Recall analysis [6]. Thematic Analysis [7] was applied in the collected data with themes to be searched either on a manifest level (to be directly observable in the information gathered) or on a latent level (underlying the phenomenon). Interaction Analysis [8] was also employed focusing on identifying patterns of verbal and non-verbal interaction among the students and between them and the visual language while interacting with the Metafora system [9].

3. Development of the planning tools

First stage: literature review

An extensive review of the literature on learning as a process of shared inquiry [10] was followed by the synthesis of accounts to produce a joint set of stages and activities. We called this a ‘superset’ as it included all the approaches reviewed. This is presented in figure 1: the first stage of our visual language.

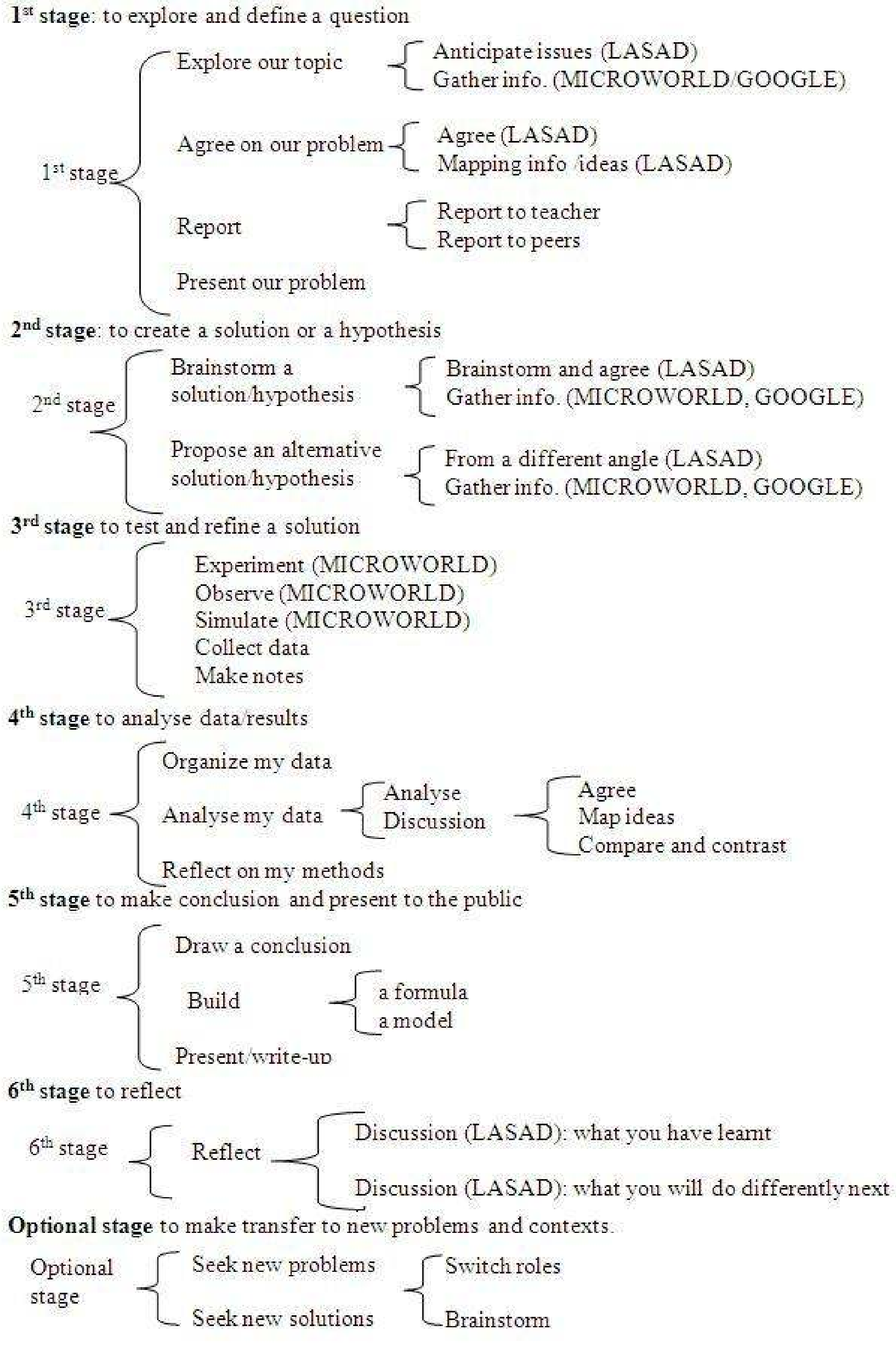


Figure 1: A first stage visual language

Figure 1: the first stage of our visual language

Design workshops

The visual language went through 3 stages of development each of which was tested and refined through design workshops:

1) One-dimensional visual language framework: at this stage the visual language only involves activities of a dialogic learning process.
2) Two-dimensional visual language framework: at this stage the visual language involves activities and key intersubjective orientations (i.e. attitudes) of a dialogic learning process.
3) Six categories of the visual language: at this stage the visual language is further developed to involve six categories. It is enriched as a better language to describe a dialogic learning process.

From a one-dimensional framework, a two-dimensional framework, to the enriched six categories, the visual language was designed and developed through four iterative cycles of evaluation.

Final visual language

As a result of the refinements and augmentations suggested by teachers and students in the design workshops and by our analysis of the data from the design workshops we developed a stable visual language for implementation in the Metafora planning and reflection tool. This final visual language had 6 types of components:

1) Main activity stages implemented as icons in blue boxes: Explore, Reach agreement, Define questions, Build model, Find hypothesis, Test model, Refine model, Draw conclusions, Prepare presentation, Reflect on process, Blank (for students to define if required)
2) Activity processes that occur within each phase implemented as icons in green circles that attach to the boxes: Build, Experiment, Hypothesize, Make notes, Propose an alternative, Report, Reach agreement, Anticipate, Brainstorm, Evaluate, Gather information, Present, Reflect, Discuss, Simulate, Analyze, Allocate roles, Blank (for students to define if required)
3) Attitudes implemented as icons in different coloured hats: Open, Positive, Critical, Creative, Ethical, Rational, Intuitive, Blank (for students to define if required)
4) Roles, implemented as icons in yellow circles: Manager, Evaluator, Notetaker, Blank (for students to define if required)
5) Products and resources, implemented as grey icons: these are the products of activities that can also serve as resources for other activities and include documents, videos and presentations in the format: PDF, PPT or MP4.
6) Connectors implemented as black and red arrows.
   The visual appearance of these icons is illustrated in Figure 2: The Metafora Planning and Reflection Tool Interface.

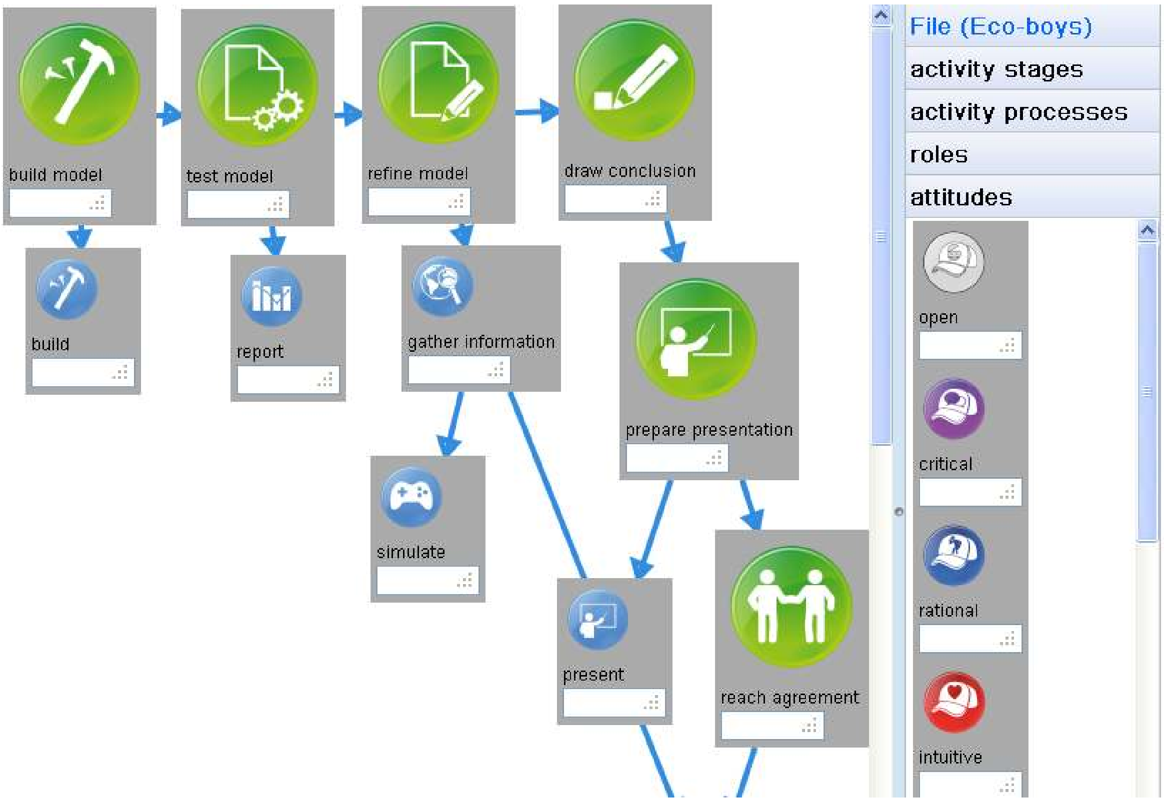


Figure 2: The Metafora Planning and Reflection Tool Interface.

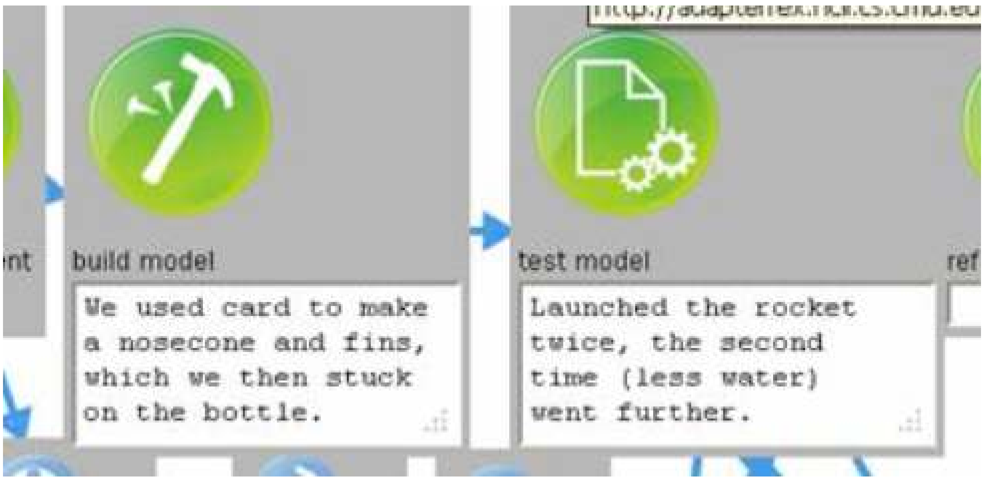
The design and evaluation of the visuals was a process that involved not only the designers and the researchers of the project partners but also involved end users teachers and students. To further illustrate the process of evaluation by end users we offer some details on the design workshop that took place in Athens Greece with six 7th grade students. This workshop had a dual aim: a) to understand if the visuals selected point to the label of the visual language components (e.g. brainstorm, be creative etc) and b)to investigate what is the meaning students attribute to the visual language components. To this end we asked students to engage in a matching task. Specifically the visuals and their labels were split and mixed in the two columns of a table, students were expected to drag next to the visual the label they considered that better corresponded to the visual. While engaged in this task students argued for their selections and explained them by referring not only to what they thought the visual was depicting but also to how the perceived the label. For example when one group with three students was discussing the brainstorm picture one of them said: "this one should stand for brainstorm (see fig 2.) because you start with something you do not know, that's why the question mark in the middle, and then you need to come up with as many ideas as possible about this". In cases where students couldn't find the match for a label they would suggest a visual that they thought relevant. Students' comments and mismatches were taken into account for refining the visual language.

Findings

The data collected in each iteration of the research were analysed and the results of this analysis fed into the development of the final version of the visual language. This has now been implemented in the Metafora system and data are being collected from trials of that system which will be analysed to investigate the role of the visual language in supporting the learning of how to learn together.

In each of the design workshops there were many different variables, different age students, use of laminated cards in some and computer interface in others, different subject area teachers, different challenges (the stimulus question asked of the students), different pedagogical approaches and different cultural and linguistic traditions. Nonetheless an overarching conclusion does emerge from all these which is that the use of the visual language to plan research-stimulated discussion and reflection on the group learning process. Observation of the planning process combined with feedback from interviews with the students afterwards suggests that the presence of the cards stimulated students to consider aspects of the research process that they would not have thought of otherwise. There was a tendency to try to use all the cards, which was not always appropriate and will have to be dealt with through the way in which the activity is prepared by the teacher. Nonetheless this use of the cards made them consider the need to build models, test models, take notes, observe, reflect on observations etc. Secondary science teachers in Lleida, Spain and in Bodmin, UK fed back in interviews that they valued the visual language because it gave the children the vocabulary that they need to understand the process of inquiry and this was a key aspect of the science curriculum in both countries. In London, UK, Athens, Greece there was some concern that the visual language was too complex and that it did not always fit the task set. This feedback raises questions of the amount of preparation needed and the appropriateness of tasks which will be explored in the next year of the project.

One example that can illustrate the finding that the visual language helped students to acquire an appropriate vocabulary for the key components of inquiry is given below. In this case the students have enacted their plan outside of the classroom and were then encouraged to reflect on their learning activities by looking at their plan again. This group of students spontaneously used the planning tool to describe the details of each activity using the cards appropriately.



4. Conclusions

Learning how to learn together (L2L2) is a key complex skill or competence for knowledge age work. The Metafora project aims at developing a better understanding of this complex skill through specifying key features of learning together processes that students need to be aware of and able to work with, and by embodying these features in a visual language which forms the main component of a planning and reflection tool. In this paper we have reported on the development process of this visual language through literature review and three rounds of design workshops. This is the first year of a three year project. The results so far are promising but research continues. Findings suggest that the visual language we have developed can help raise students' awareness of key aspects and components of their collaborative learning processes. The next stage will evaluate the tool as a support for reflection while students are enacting shared projects. Further research is needed to investigate the impact of using this tool on the ability of students to learn together with others in new situations.

The development of this visual language and its initial successful trials has potential significance. For example, the tool has shown itself to be of value to science teachers who need to teach not only the content of science but also the process of scientific enquiry. In mathematics, teachers have commented that it allows for setting complex challenges, which students can undertake as homework using the web over a period of time. By working in groups in their own time and space and because of the ability of the teacher to monitor and help when needed it makes possible something that would be otherwise very difficult. This web-based support for groups learning to learn together has to prove its significance in more disciplinary fields, across educational contexts, but even beyond classroom education. It remains to be seen whether and how it could be used to support social learning building in many more specialised fields or in building on everyday practice such as the current success of social networking. Further research is planned to explore the potential of the Metafora planning and reflection tool to support distributed individuals learning together via the web.

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