Fostering the Use of ICT in Pedagogical Practices in Science Education

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Summary

The FICTUP project (Fostering the Use of ICT in Pedagogical Practices), funded with the support of the Lifelong Learning Programme of the European Union, aims to (1) create innovative training materials that suggest concrete pedagogical activities using ICT, accompanied by a close tutoring process, and (2) test the impact of the material and the tutoring on novice teachers' use of ICT in the classroom.

The innovative training material, developed collaboratively by both experienced and novice teachers to ensure its accessibility, focuses on specific classroom activities that use ICT. Each case includes a detailed description of the activity (PDF file) and three short, pedagogical videos (ca. 2-6 minutes each) that describe the transversal ICT skills brought into play during the activity. During the first year of the project, nine cases were implemented, some of which focused explicitly on the use of ICT in science education. This paper presents a number of different sample applications, such as “Device - measurement - evaluation: Use of ICT in physics (Hungary)”, “Exploring growth factors: Applying inquiry learning in biology (Finland)”, and “GeoGebra software: Mathematics teaching (France)”.

The increased use of ICT has led to the introduction of new pedagogical approaches, including Resource Based Learning (RBL) where varied learning needs are supported by a wide range of ICT assets. Science subjects in particular are extremely amenable to the advantages offered by RBL and the associated ICT assets. The implementation of technology-supported collaborative inquiry allows teachers to design the educational setting as an integrated whole that provides students with relevant technological tools, directs them to collaborate effectively, and promotes epistemologically high-level and creative ways of working with knowledge.

Keywords: case study, ICT, Resource Based Learning (RBL), teacher training

The FICTUP project

The FICTUP project (Fostering the Use of ICT in Pedagogical Practices), funded with the support of the Lifelong Learning Programme of the European Union, aims at creating innovative training materials describing concrete pedagogical activities using ICT, experimenting a close tutoring process among experienced and novice[1] teachers, and providing training institutions with recommendations based on the experimentations.

The project continues the work carried out in the frame of the French Auperel project - sustained by the French Ministry of Education and Research - by associating European partners. Auperel - Analysis of the pedagogical uses of online resources - showed that, among the teachers who do not use ICT with their pupils frequently, an important majority would like to do so but feel that they do not have the necessary skills (Leclère et al., 2007). The objective of the FICTUP project is thus to **create innovative training materials describing pedagogical activities using ICT**, associated with a close tutoring process; and to test the impact of this material and human support on novice teachers while using ICT in class.

During the first year of the project, the training materials have been developed collaboratively by experienced and novice teachers to make the knowledge transfer as smooth as possible. Each case includes the detailed description of the activities of a learning scenario in class (PDF file) and three associated short pedagogical videos (ca. 2-6 minutes each). Some of these cases focus explicitly on the use of ICT in science education, and this paper presents some sample applications in the following sections. All outcomes are available online under http://fictup.inpl-nancy.fr/index.php/Pedagogical_scenarios.

From March to July 2010, the training materials are tested in real conditions by novice teachers[2], who are implementing the pedagogical activities in class, supported by a close **tutoring process** with the experienced teacher who took part in the elaboration and the trial of the learning materials and videos. The process is being documented by the novice teacher through a teacher log. It is partially observed (with filming) by researchers. All data are going to be analysed and evaluated by researchers. The final objective is to use the outcome of this trial period to adapt and improve the experimented training methodology (mainly the organisation of tutoring, terms of reference for the pedagogical materials) and to propose it to educational institutions for further exploitation.

Starting with a short review on the use of case based instructions and video materials for teacher training, this article provides an introduction to pedagogical approaches in science teaching and associated ICT assets, followed by the description of three sample applications linked to the use of ICT in science education, developed within the FICTUP project. Finally, we present some assumptions on the impact of ICT enhanced learning on pedagogical approaches that will be examined in the evaluation phase of the project.

Case based instructions and video materials

Teaching with ICT requires many skills. Among many factors affecting teachers' use of ICT (for a review, see e. g. Mumtaz, 2000), teachers may think that their students – sometimes called "digital natives" – have developed more ICT skills than they do, and consider the implementation of such pedagogical sequences risky. For teachers, cases based on real classroom situations may serve a number of pedagogical goals: they give exemplars of teaching situations and they may foster the practice of analysis. "The case representation is a means of narrowing the gap between general knowledge about principles and procedures, and enactment in real classrooms" (Van den Berg et al., 2008). Adding videos to narrative written cases may help

[1] Here, the term « novice » refers to a teacher who has never used such ICT tools with his/her students in class.
[2] The novice teachers who implement the cases during the second step of the project are different from the ones who participated to conceive the materials during the first year.

teachers better understand the case and the teaching situation, as well as the reasons, methods or technicalities of using technology within a given context. The videos can provide a useful description of ICT tools applied, and a clear representation of teaching practices with ICT. However, videos can be watched passively and it is not sure that novice teachers are able to improve their practices just by viewing them. Therefore, a tutoring process seems necessary, in order to create discussions between an experienced and a novice teacher who would like to implement the case in his/her own classroom. The aim of the FICTUP project is to create such training materials and to test and enhance a model of tutoring process.

Pedagogical approaches in science teaching and associated ICT assets

Science teaching has traditionally being based on the use of two contrasting pedagogical approaches, the so called “Deductive” and “Inductive” approaches. The “Deductive” approach may be identified as as the traditionally applied model in the school environment that traditionally applied in the school classroom environment. It aims to provide students with a broad standard knowledge base, while the “Inductive” approach, more commonly employed in Third Level educational settings, anticipates that students already have a certain level of knowledge and can have a certain degree of autonomy / self direction within the learning process. It is increasingly evident that these approaches are not mutually exclusive or exclusively associated with one learning context or another.

The “Deductive” or as it is often referred the “Top-Down” approach is characterised by the teacher introducing the students to a particular concept and its associated (downstream and upstream) logical or “deductive “implications together with a suitable array of meaningful and explanatory examples of its “downstream” application or impact. Upstream influences are by nature more abstract and theoretical and tangible exemplars rarely if ever available. One of the difficulties of this approach with Science teaching is that the students must handle abstract ideas (which is not always easy, and certainly not for pre-secondary and very often even for secondary school students). The scope of some of the concepts is often considerably greater than what can be easily handled by the teachers themselves. Accommodating such elements within the given curriculum constraints means that students often must make a “leap of faith” as regards the veracity or logic of what they learn. They may often learn how in an “instructional heavy” environment but often have to suspend their inclination to ask why – ironically one of the very attributes essential to effective knowledge development within science.

The “Inductive “ or “Bottom-Up” approach provides greater opportunity for observation, experimentation and self-driven knowledge acquisition. Within particular subject areas, particularly that of science, the approach has been championed and refined and is commonly referred to as Inquiry Based Science Learning (ISBE). ISBE tackles some of the aforementioned difficulties associated with the “Deductive“ approach and is commonly applied within areas of study related to science nature and technology. It is more commonly referred to as Problem Based Learning when applied to the sciences of mathematics and engineering. ISBE may be considered a Problem Based Learning approach but its scope is considerably wider than that of PBL with greater emphasis placed on experimentation. A drawback of ISBE and the Inductive approach in general is the fact that students must have a basic knowledge level to avail of the opportunities provided. Moreover, when it is used to provide a basic knowledge foundation, it is difficult to ensure that all students attain the basic level required, as the approach may facilitate the development of the more adept students with a better knowledge base or greater academic ability at the expense of weaker students. By its very nature ISBE is a more intense / time consuming approach and together with the above mentioned drawback it is little wonder why it is more commonly encountered in and suited to Third-Level or specialist educational settings.

In addition to the common use of both approaches in teaching science, the technological advances that have occurred during the last 15 – 20 years have revolutionized how modern learning environments are being defined and perceived by educationalists and as a direct consequence the approaches to knowledge creation and transmission. The rapid and ever increasing application and adoption of information based technologies such as the Internet and the World Wide Web make it no longer accurate or effective to perceive pedagogical strategies as being of one type or another or to apply presupposed constraints on the type of learning environment for which they are considered appropriate. The increased application of ICT has led to the introduction of new pedagogical approaches such as Resource Based Learning (RBL) where varied learning needs are supported by a wide range of available ICT assets. Science subjects in particular are extremely amenable to the advantages offered by RBL and its associated ICT assets.

Resource-based learning makes use of a broad range of information resources and learning supports including digital media formats and has a number of general characteristics which make it a highly suitable approach for learning Science. These include:

- A wide range of highly flexible resources that may be customised and developed to meet the particular user groups needs;
- Unlimited and near instant access to extensive resources (paper-based, electronic, people) from an endless variety of sources not previously accessible;
- Economic advantages associated with increased knowledge sharing and interactive knowledge development within different or related contexts;
- The inherent development and expansion of peer processes and peer review together with greater transparency and possibility of concurrence within the given fields of study that also lessens the degree of political infighting that so often hampers the expansion of scientific frontiers and knowledge development.

An example of the specific advantages associated with RBL for Science Teaching includes the use of Computer simulation. Computer simulation permits users to operate in a safe virtual environment. The nature of computer simulation allows experimentation with the choice and use of rules, procedures and activities in various scenarios. At the same time, it also avoids the extreme consequences that might occur with such experimentation in a real world scenario. In addition, users have the opportunity to make decisions, to evaluate the likely consequences of their actions and develop and refine their judgment and decision making process. Computer simulation gives the user an improved understanding of what a particular role entails in a flexible and risk free manner. The ability of Computer simulation to stimulate curiosity and encourage trial-and-error experimentation in a safe virtual environment is undoubtedly one of the benefits brought by ICT in science education. Furthermore, students learn through play, and playing is usually synonymous with having fun. Playing has an important role in the psychological, social and intellectual development of children. An inherent advantage of computer software and simulations is that they are particularly suited to the creation of “play environments” where motivation and fun co-exist and provide a powerful learning experience.

The following sections provide some practical examples of the use of ICT in science education, through the presentation of three case descriptions developed within the FICTUP project.

Device – measurement – evaluation: Use of ICT in physics (Hungary)

This activity consists of four 45-minutes lessons, involving a group of 12 students (half class). The students work in groups of four. First they create a gas thermometer and make measurements to find the absolute zero degree. Then they analyse the data using Sinequanon software that helps to find the right curve. They document each step of the process with digital photos and videos, in order to create a "how to" presentation for anyone interested in reproducing the process. When ready, they convert their presentation into an online version with the help of the free Calaméo tool. At the end of the project, students give oral presentations of their findings and the process.

Pedagogical context

The described lessons are carried out during lessons of Physics focusing on experiments made by pupils. Such lessons are attended by pupils once a week for half a year in grade 9. They provide excellent opportunities for carrying out experiments required at the lower and higher level secondary school-leaving examination and for acquiring scientific methodology applied in experiments. Students get observation tasks and start observations and constructing measurement tools in pairs or small groups from grade 5 during integrated science lessons. This activity goes on from grade 7, when they do not learn integrated science any more but Physics, Chemistry, Geography and Biology. Preparing presentations starts in grade 5. Most subjects offer opportunities for preparing presentations once or twice a year individually, in pairs or in small groups. Taking photos, making videos and editing photos and videos by using various pieces of software are optional projects for pupils in grades 7 and 8 at the school where the session was designed and first tested.

Objectives

To facilitate a typified science acquisition process by ICT tools that can act as a framework for carrying out and processing other experiments as well. In this case the acquisition process includes the following steps:

- taking photos of the various steps of preparing a gas thermometer;
- shooting a video of the gas thermometer in action, using the video for observing and studying the phenomenon of thermal expansion;
- selecting and measuring the physical quantities characterising thermal expansion;
- recording and analyzing the measurement data (temperature and volume);
- finding and recognizing connections between the data of measurement;
- using the recognized linear connection to introduce Kelvin scale, to define absolute zero degree.

ICT tools used

Sinequanon (http://pagesperso-orange.fr/patrice.rabiller/SineQuaNon/menusqn.htm)
It is a free piece of software that facilitates measurement data management, the evaluation of measurement data, and the presentation of these data in the Cartesian coordinate system. Various functions can be assigned to the presented data, which facilitates describing the examined phenomenon and recognizing connections among the measured data. It can mostly be used effectively in science and mathematics lessons. In addition to the presented use it can be applied for teaching geometry, statistics and mathematical functions.

Calaméo (http://fr.calameo.com/)
An online presentation tool, a free version which makes the conversion and publication of MSWord, MSExcel, MSPowerPoint, Pdf, OpenOffice files possible up to 100 Mb. It also provides opportunities for uploading the presentations to YouTube this way they can also be commented. Group work is made more efficient by giving a background for presenting measurement results.

PhotoFiltre (www.photofiltre.com)
The free version of this image adjusting and retouching programme makes it possible to edit, prepare and insert digitally recorded images into a selected presentation tool. The time necessary for uploading can be shortened by reducing the size of the photos.

Exploring growth factors: Applying inquiry learning in biology (Finland)

Primary school students study wild courtyard plants and practice the construction of a simple experimental design related to growth factors. They carry out an inquiry project in teams, practicing complex scientific skills such as the formulation of research questions and hypotheses, information search, making and documenting observations, writing, etc. The 10-lesson inquiry process is coordinated, documented and shared using a Web-based collaboration environment and its virtual forums.

Pedagogical context

The project was carried out with 3rd grade pupils (9-10 years of age) in primary school in science lessons. The topic of the project was the influence of growth factors for courtyard plants; it was part of a longer period where pupils studied plant biology. The project was meant as a first introduction to scientific and collaborative working practices using web-based collaboration tools to support the work. Required skills were mediocre reading and writing skills. General ICT skills that pupils were supposed to have for the project were: logging in the computer, basic skills for using a keyboard, using a mouse, understanding what saving means, opening the browser, and logging in the web-based environment. In the example project, some pupils had used the web-based environment and its discussion forums somewhat in the second grade, but for some pupils the tools were new. It is not necessary to have previous experience of the web-based tool because in each phase the teacher explains and shows the basic procedures. The context for the project was created before the start of the research process by studying the structure and diversity of plants: roots, stalks and leafs. Another topic was the naming of plant species; plant names were needed during the research process.

Objectives

The goal of the project was, especially, to introduce progressive inquiry (see Hakkarainen, 2003; http://en.wikipedia.org/wiki/Progressive_inquiry), collaborative working and science practices for primary school pupils. Content objectives of the sequence were to understand the scientific content of the chosen topic in context: The role of growth factors for wild courtyard plants. The pupils were supposed to study courtyard plants in small research teams and to practice the construction of a simple experimental design related to growth factors. They compared the length of plants in two growing areas and explained the differences with theoretical knowledge. The project also had objectives regarding the improvement of more general skills, such as science skills (defining research questions and hypotheses, scientific problem solving, or making and documenting observations), skills for information search and categorisation of knowledge, collaboration skills, presentation and writing skills, or skills related to the use of ICT for collaborative inquiry practices (good routines for web discussions, how to comment on others' ideas, etc.).

ICT tools used

All phases of the inquiry process, such as generation of research questions and hypotheses, documentation and explanation of observations and information search were organized and shared through web-based tools. A **web-based learning environment** (FRONTER in the example; see http://com.fronter.info) was used for this purpose. It was used for structuring the progressive inquiry project through the working spaces and written instructions created by the teacher; collaboratively sharing and commenting on ideas and explanations; documenting the research process and presenting the results; and sharing information resources when they were needed for the inquiry process. In the progressive inquiry approach, information resources are used for special purposes depending on the process phase (e.g., for creating the context in the beginning, or as a source for deepening knowledge after the pupils have first tried to explain the phenomena and answer the questions through their previous knowledge or own observations). In the example project, FRONTER was used because it was the system that was used in all schools in the City of Helsinki at the time of the experiment. In principle, any web-based learning or working environment is suitable for this kind of practice, if it includes tools for web-discussions and for creating web documents with text, pictures and links. Other suitable systems could be, for instance, Moodle (http://moodle.com) or Google Groups (http://groups.google.com).

In addition to the web-based environment, an **interactive white board** was used in several phases of the process for various purposes. The teacher used it as a presentation tool when he showed written instructions for students or demonstrated the usage of the web-based system, and also the pupils presented their team's inquiry outcomes to other teams using the whiteboard as a presentation tool in the end of the project. In addition, the whiteboard was also used as a shared interactive space through which the whole study group examined together the ideas and explanations that they had produced during the process. The teacher had a nice practice for collecting all pupils into a collaborative session in front of the whiteboard to examine and evaluate pupils' contributions in the web-based system.

If the teacher and pupils want to attach a photo or photos of the field observations or other phases of the inquiry process into the pupils' final reports, a **digital photo or video camera** is need. In the example project, the teacher took a photo for each group, but pupils could also take photos themselves. Sometimes also mobile phones could be used for the same purpose.

GeoGebra software: Mathematics teaching (France)

This case describes the use of the Geogebra software in mathematics teaching in a Higher Secondary School. This is a 5-hours activity carried out once a week with the aim to illustrate, observe, take initiatives, speculate and argue working on the maths curriculum using Geogebra, a dynamic geometry tool and spreadsheet programme.

Pedagogical context

The experiment took place in a Grade Two *(Seconde)* General Baccalaureate class (for 14-15 year-olds) with 32 students, of whom 24 were girls and 8 were boys. Sixteen students were studying for the Economic and Social Science Option and seventeen were top-level athletes from the regional sports academy (CREPS). The class was predominantly made up of pleasant, amenable students. The overall level was satisfactory, although there were wide disparities. The experiment took place from Thursday 28 April to 4 June 2009. By this time in the year, students had already made their subject choices: one student had opted for Management Science and Technology, ten for Economics and Social Science and eight for Science. Their motivation and consequent level of attention in class varied depending on their choices.

The only experience of the software the students had had before the experiment was as observers. The teacher had regularly used it with the video projector to correct exercises or give examples in class. The students had thus never used the software, although some of them (four or five) said that they had used similar software programmes at lower secondary school. Within the school, students had often used computers but usually for research purposes in Civic, Legal and Social Education and Earth and Life Science, in which they had made presentations in pairs.

In the Mathematics class, the teacher used a form of progress called spiral progression, which is common to all second grades at the school: the main notions are dealt with very early on and then topped up throughout the year. Session 1 only required basic lower secondary school level geometry and could be tackled at any time during the year. Session 2 required knowledge of linear functions and some notions of linear equations in graphs using points.

Sessions 3, 4 and 5 required some basic knowledge about functions and a degree of understanding of algebraic calculations. The teacher and the class had become accustomed to starting activities with a joint discussion to debate possible problem-solving strategies and to pool results further to students' individual research. This method would be used during the ICT sessions.

Objectives

Besides enabling students to acquire mathematics skills, the use of software programmes such as GeoGebra help them learn to experiment, observe, develop and enhance a scientific approach. Problem-solving using the software programme gives mathematics activities a purpose. The modelling of everyday problems develops students' autonomy and sense of initiative. During ICT activities, students have to present the results of their experiments orally or in writing. They have to draw on argumentation, critical analysis and debating skills.

ICT tools used

GeoGebra (http://www.GeoGebra.org) is a dynamic free mathematics software for all levels of education that includes arithmetic, geometry, algebra and calculus. On the one hand, GeoGebra is an interactive geometry system. It allows teachers and students to do constructions with points, vectors, segments, lines, conic sections as well as functions and change them dynamically afterwards. On the other hand, equations and coordinates can be entered directly. Thus, GeoGebra has the ability to deal with variables for numbers, vectors and points, finds derivatives and integrals of functions. These two views are characteristic of GeoGebra: an expression in the algebra view corresponds to an object in the graphics view and vice versa.

The microworld: GeoGebra is a member of the microworld family. Microworld (for more information, please refer to the person who invented this concept in the 1980s, Seymour Papert) is a virtual environment that enables learners to experiment and thus to build their knowledge. It is therefore a tool that can be used to promote the constructivist approach dear to Piaget, from which Bruner (1990) drew inspiration when he developed a theory that places learners at the heart of learning processes and enables them to forge new concepts on the basis of existing knowledge. Several educational software programmes have been developed on the basis of this concept, with the LOGO programming language being the most representative example.

As Bellemain and Capponi (1992) emphasise, "software programmes foster the development of procedures of an analytical nature in the reproduction or construction of geometric figures… The obligation to enter a geometric construction process into the programme thus helps to define the geometric object".

The impact of ICT enhanced learning on pedagogical approaches and its assessment

Based on the new technologies and the technology enhanced research-based knowledge available, some educational assumptions can be proposed that teachers have to take into account, in particular to define strategies and pedagogical approaches that could best benefit from the use of ICT.

According to the characteristics of the different kinds of ICT analysed and the learning contexts where they can be applied, different pedagogical approaches for the use of new technologies are put into practice. One concerns the "individualisation – personalisation" approach and thus the importance to plan and organise teaching and learning activities in order to find a good balance between the students' needs for individualisation and personalisation. Focusing on individualisation or personalisation means making very different educational choices in terms of goals, methods, technologies, learning strategies and evaluation. It is important to be very clear about the educational goals to be reached when planning educational activities, in order to give students both the opportunity, for every topic, to learn the basics and to deepen their personal interests and views thereabout.

According to previous studies in Finnish schools (Lakkala, Lallimo & Hakkarainen, 2005; Lakkala, Ilomäki & Palonen, 2007), the implementation of technology-supported collaborative inquiry practices assumes teachers to design the educational setting as an integrated whole that provides students with relevant technological tools, directs them to collaborate effectively, and promotes epistemologically high-level and creative working with knowledge.

In the sample case “Exploring growth factors: Applying inquiry learning in biology”, for example, the experienced teacher demonstrated various practices, which can be considered to have promoted inquiry learning. To begin with, the teacher used the concrete illustration of the Progressive Inquiry model to teach expert-like inquiry practices for students. He introduced pupils with versatile tools and taught them concrete practices to use separate tools for different purposes and to manage multiple working spaces. He modelled the working strategies through cumulative guidelines written in the web-based environment and gradually tried to promote the students to manage for themselves through following the instructions. In every working phase, the teacher gave explicit recommendations and guidelines for appropriate and effective ways of working and collaboration both face-to-face and virtually, and also took care that the pupils worked in a proper way. The teacher gave students much responsibility in their group work, but all the time walked around the classroom and monitored whether some groups needed coaching in effective knowledge and collaboration practices.

In the sample case “Device – measurement – evaluation: Use of ICT in physics (Hungary)”, for example, it has been anticipated that students would be highly interested and engaged in the ICT-rich learning processes, and also that the presentation of the learning outcome would be more professional thanks to the use of ICT. The teacher interviews, logs and observations proved that all processes where students are active participants are much more motivating. Using technology brings these processes closer to the way students solve problems outside the school. They seem to enjoy all the ICT options when they can communicate, collaborate and create, and also publish online. Web2.0 tools are part of their everyday life and they can also use them for learning purposes. As in many of his lectures and also in his weblog professor Stephen Heppel says, in ICT the most important element is C, which means communication. Students used all the communication tools they were offered in a very efficient way, let it be forums of different platforms (e.g. Moodle), or online presentations (e.g. Calaméo).

Concerning assessment, it is very important to apply both formative and summative assessment in order to evaluate teaching/learning processes and products and to adjust teaching strategies to students’ characteristics (Genovese, 2006). Many tools and assessment methods can be used to assess the effectiveness of ICT (observation, check lists, interviews, satisfaction questionnaires, tests, etc.), also the knowledge and skills gained while learning with the help of ICT. It is often stated that assessment methods should be in tune with the methods of learning. If ICT is used for learning, it should also be present at assessing the results of learning.

ICT enhanced science teaching at school

To sum up, various kinds of technologies can be used in science teaching at school. Some applications are domain specific and thus designed for a certain purpose, like measurement tools for laboratory experiments or digital learning materials and learning objects (e.g. Wiley, 2002) made available through the Web. In addition, generic virtual learning environments or recent social software applications are increasingly used in teaching especially to support collaborative, inquiry and project-based learning approaches. In such approaches, technology supports collaborative work, e.g. by providing spaces through which everybody has access to the same material; tools for group communication and co-construction of various kinds of products; saving of the whole working process for further re-use and reflection as well as tools for structuring and organizing the collaborative actions (Lipponen & Lallimo, 2004; Rubens et al., 2005).

Follow-up of recent developments

If you are interested in the **FICTUP project** and keen to **learn more about ICT enhanced pedagogical activities and tools**, you can also follow up these topics on **Twitter**, in addition to the official project newsletter. Different Twitter accounts have been created to cover the partnership's languages, i.e. English, Finnish, French, Hungarian and Italian.

Newsletters with information on national events, news and initiatives related to the use of ICT in pedagogical practices in Europe are disseminated to a public distribution list open to teachers, teacher trainers, teacher students, teacher training institutions, universities, decision makers, contributors and all other persons involved and interested in the project. FICTUP newsletters are available in English, French, Italian and Hungarian.

All information - including the detailed descriptions of all cases and the videos - can be also accessed through the **project web site** at http://fictup.inpl-nancy.fr.

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