A wiki-based active learning system; how to enhance learning material in epistemology of computer science and computer ethics

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This paper presents a seminal work in preparing lecture notes in epistemology of computer science and computer ethics through an open source personal wiki system engine. Our course of epistemology of computer science and computer ethics aims at making graduate students think about the fundamentals of the discipline as a science and as a profession, so we encourage a 'learning by doing' approach. Preliminary results of the comparison between a standard word processor-based and a wiki-based lecture notes system are given.

Keywords personal wiki; active learning; philosophy of computer science; computer ethics; mind map.

1. Introduction

Epistemology of computer science is a relatively new discipline, and thus quite fragmented. Its goal is to investigate the different theories of knowledge underlying computer science and informatics, as well as Artificial Intelligence. The reasons for its fragmentation, apart from its novelty, may be found in the different backgrounds of the researchers – see at least [1, 2, 3 and 4] for a survey. Consequently, it's not simple to give a comprehensive and complete account of the discipline. This is the reason why there isn't any comprehensive textbook in epistemology of computer science, although some reference texts are generally acknowledged, e.g. Turing's classics [5, 6] or the famous Chinese Room argument by Searle [7]. Our *fil rouge* in presenting the main arguments follows some recurrent key questions in the literature, such as: is computer science really a science? How should an empirical experiment in computer science be carried out? For example, what is the status of knowledge gained from conducting an experiment in evolutionary or genetic programming? What are the differences, if any, from the empirical experiments used in natural sciences? We soon realized that these key questions are correctly addressed after an introduction to the history of computation and logic. In particular, our course begins with a brief survey of the most important moments in the history of logical thinking, e.g. from Aristotle and Raimond Lull to George Boole and beyond. At the same time, we show the profound relationship to the developments of the calculating machines, more specifically from the abacus to Babbage's machines up to modern computers. We find that a historical perspective greatly helps our students to relativize problems, i.e. to understand the main topics in a more general way, as for example, the imitation game by Turing [5] or the symbol grounding problem by Harnad [8].

The second part of our lectures delves into computer ethics issues. We feel that a good command of the main philosophical and social implications of computer science technologies may improve self-awareness of informatics professionals and leads to a better behavious in their professional life. Professional deontological issues are considered apart as a special case, at the very end of the course itself. Although computer ethics issues started as a branch of epistemology of computer science, this field has achieved a status of relative autonomy, at least since the fundamental work of Deborah Johnson [9]. The starting point of computer ethics is quite simple and straighforward. In fact, various authors from different perspectives argue that technology should not be considered as a social monad, i.e. a

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factor neutral in relation to social change. On the contrary, technology in general should be considered as socially determined. In some cases it plays the role of an explicit vehicle of social and indeed even of political implications – the debate between free software and open source software is a paradigmatic case, whose implications are far deeper than a mere terminological question [10].

2. Educational aspects and the role of technology

As far as we know, our course in epistemology of computer science and computer ethics is the first experience of this kind in Italy. Therefore, we had to prepare lecture notes as an original work, at least for the main topics, since there is almost no material in Italian about these disciplines. Furthermore, as explained before, theoretical perspectives and empirical data source are rarely integrated. In our view, the lecture notes should be considered both as a preliminary textbook for our students and, far more importantly, as the starting point to their homework. In fact, as the main educational goal is to raise our students' awareness of the key questions behind the profession they are going to be enrolled in, we are applying a constructivist approach. Instead of considering ourselves as experts who give closed material following increasingly levels of difficulty, and the students as people who should absorb and retain readily understandable content, we prefer a methodology based on active tasks. In this way we reach two additional goals: (a) we may be surprised by the active tasks performed by students and so learn something new obtaining good feedback for what we teach; (b) active tasks commit students to learn about learning, i.e. they metalearn, in particular rhetorics and logics of argumentative writing.

More specifically, we strongly encourage a 'learning by doing' methodology with various incentives. First of all, each student's assignment (some brief argumentative texts written on current topics during lectures) and a final essay (a longer investigation, a study in depth, written sometimes in teams of two) cover the 33% of the final evaluation – the rest being a standard written test and an oral examination. For the evaluation of students' work we apply a blind peer review methodology also providing an instruction file for authors, an explanation of the evaluation criteria and a style sheet for submission, such as those used during scientific conferences. Our style sheet is both in Latex and in PDF formats – students may choose either a typography language such as Latex or a word processor such as Microsoft Word in writing.

After two years of experience in this course, we wanted to try to integrate the best assessments written by our students as complementary material, along with more traditional learning content, e.g. classical papers, book chapters and web resources. Students' assessments generally improved when they were told that the best assessments would become complementary documents for future student. Morevoer, one of the last lectures is given directly by the most involved students, in the form of an oral presentation, again following the conference model: 15 minutes each, 5 minutes for questions (note that the most compelling questions come from the students themselves). As an additional stimulus, we give extra points to students who give the oral presentation. Recently we launched a sort of prize for the best long essay of the year.

Perhaps the best students' assessments we have obtained so far are the ones about writing technologies, e.g. reflections on the advantages and limits of 'new texts' as blogs, wikis, folksonomies, etc. as new writing tools. It is surprising that, in spite of this important result, most students treat our lecture notes reverentially, as 'silver bullets', i.e. ontological entities outside society, space and time, with some immutable characteristics that magically lead to the right solution. Moreover, some lectures are dedicated to deconstructing the myth of new and old writing media, such as, the web as an always trustable source of public information and books as the unique media carrying state-of-the-art knowledge on every imaginable topic. On the contrary, we consider our lecture notes both as a work in progress and as an arena for collaborative knowledge. In particular, we want to emphasize that lecture notes play a role as guidelines on arguments and topics, and their contents may be trusted and at the same time expanded and annotated by students. Initially, we wrote lecture notes through a word processor, but this writing technology doesn't encourage particularly active studying. We thus decided to change our writing paradigm, adopting a wiki-based technology.

3. Advantages and costs of a writing technology paradigm change

The University of Insubria decided to deliver lecture notes and complementary documents through a traditional learning management system, BlackBoard. Although claimed as a market leader among learning management systems, BlackBoard has proven to be unfit to our educational purposes. In fact, the preparation of learning objects, the e-learning method followed by the platform, is very time-consuming, and the maximum of achievable interactivity is a verification test with closed questions and automatic scoring. We limited the use of closed questions during the final written examination, where closed questions are mixed with open ones, in order to verify the general level of comprehension of the main topic. In summary, we kept the use of BlackBoard to a minimum, i.e. as a web space for remote publishing. Nevertheless, in choosing the right interactive writing technology for our needs we should consider the integration issue with this e-learning platform.

Among the new text formats currently available, we find that the wiki format is the most suitable for our lecture notes. The first wiki system was developed in direct contrast to the traditional thread model followed by web forums, FAQs and mailing lists [11].

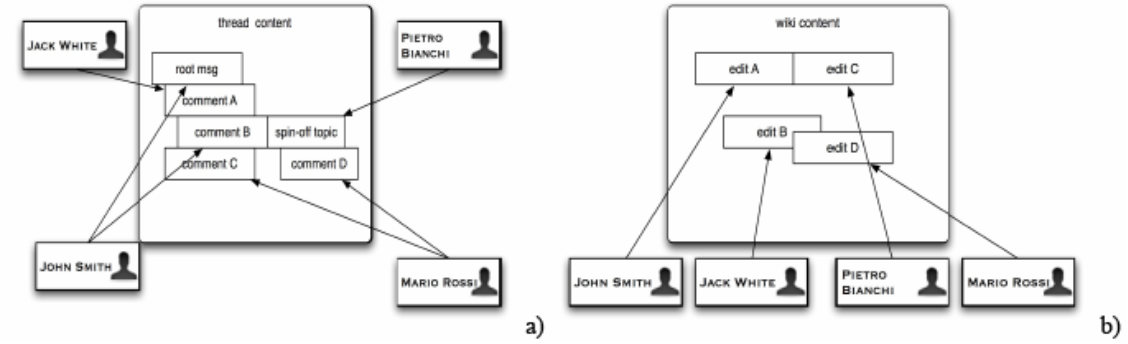

Fig. 1 The models in comparison. At the left, the traditional thread model, at the right the wiki mode.

In the thread model, the topic is decided in the root message, and commented by its descendants. No message has a particular status, so additional branches spread off very quickly. Quite often the tree of messages becomes very complex to navigate through, and retrieving meaningful content becomes more and more difficult. Moreover, the fact that every message is signed often implies that useless personalisms impinges on message content.

On the contrary, a pure wiki model builds contents collaboratively, i.e. everyone edits contents anonymously, focusing on the content itself. Of course, we can't apply the wiki model as it is, as we don't want anyone to edit lecture notes anywhere and anonymously, so we tried to find a middle way, in particular retaining the role of authorshi. The main technical requirements of the wiki system we were looking for are the following: (a) ease of converting existing lecture notes from Word format; (b) ease of publishing into the BlackBoard platform, as mentioned before; (c) presence of a revision history, in order to keep track of the different versions.

On the other hand, we wanted to find a wiki system with three basic edit modes, i.e. an edit mode, an annotation mode and a browse mode. In the 'edit mode' we, as the experts, convert the existing lecture notes from the word processor technology to the new format, updating when needed. In the 'annotation mode' students may create different paths of active reading, i.e. small texts as signed comments, as in the thread model. The main difference between the edit mode and the annotation mode is about the prestige of the texts themselves. In other words, the only thing that distinguishes one mode from the other is the author's name. It was noted elsewhere that the use of hypertext in the classroom reconfigures the role of teachers and students, giving more power (and responsibility) to the latter [12]. Our wiki system should be personal, i.e. students may annotate a personal version of the lecture notes, and eventually share their annotations under our approval, improving lecture note material for future students.

After a period of acceptance testing of various wiki system engines, we choose TiddlyWiki (http://www.tiddlywiki.com), best for our purpose, as a standard basis. TiddlyWiki is a client-side only web application, i.e. everything is contained in a single HTML file, with an embedded Javascript library written *ad hoc*. These features may fulfill the technical requirements (a) and (b), as seen above. Revision history – requirement (c) – is guaranteed, as every time users update contents TiddlyWiki saves itself in a backup file, named with a a timestamp.

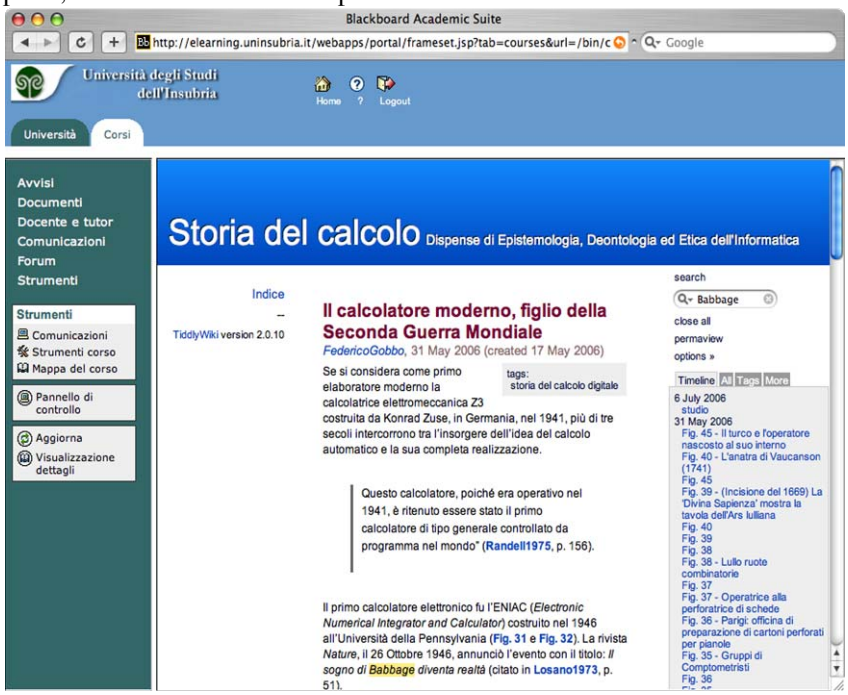

Fig. 2 The lecture notes in the TiddlyWiki format perfectly integrated in BlackBoard.

Text conversion from a word processor technology was a more time-consuming factor. It's not clear how to extract meaningdul text and its typesetting, i.e. bold, quotations, etc., in an automatic way. The hypertextual structure underlying a wiki system such as TiddlyWiki requires far more work or a mere typesetting conversion. In fact, in an hypertext the autonomous text fragments are no longer 'pages' or 'paragraphs' (the definition of a 'web page' being an oxymoron) as they can be navigated, browsed, read and annotated in multiple paths. This implies strict editing of the content ifself. For example, we were forced to resolve some anaphoras explicitly, as there is no greater guarantee of the reading order than in a classic page-turn model, i.e. a book. From now on, we will call these unit *lexias*, following Landow [12], instead of 'tiddler' as in the jargon of TiddlyWiki. Each lexia has meaningful tags, i.e. keywords that form sets of lexias, forming definite semantic areas. Our basic tagset is the following one, in alphabetical order: figure; figure reference; introduction; note; reference. Then there are additional tags depending on specific contents, e.g. history of logical calculus; objection to Turing's test.

We retain a sequential order of lexias through an index (see 'indice' at the left menu, Figure 2). When connected to BlackBoard, students may navigate the lecture notes in the browse mode, i.e. they cannot edit or annotate, but they can choose which lexias to load in the TiddlyWiki web page at the same time, e.g. every reference cited in the text. For instance, a student may want to review a picture about Ramon Llull seen during the last lecture, as it was already shown in previous one in a different context. After loading every lexia tagged 'figure' he or she quickly finds the right one, and then he or she may read the text lexias that comment that lexia through the reversed linking feature present in TiddlyWiki, i.e. a special link showing every lexia which points to the current one. Alternatively, if students don't

remember exactly why and how Babbage is importan, they may search through the whole lexia set, even using regular expressions (see search box at the top right menu, Figure 2).

In order to switch to annotation mode, a student may download a personal copy of the TiddlyWiki lecture notes, with or without figures – in fact, they are separate files. In order to avoid too heavy packages for narrow band connections and to simplify browse mode we created a single TiddlyWiki document for every main topic of the course, e.g. the historical part, Turing's test, computer deontology. The local copy has additional options at the right side menu, and a student may write new lexias to establish his or her own paths of studying, following his or her cognitive styles. The only difference between annotation mode and edit mode is the right to upload the TiddlyWiki files to the e-learning platform. A local copy may be distinguished by the more articulated right menu.

4. Conclusions and further work

We presented a new approach for publishing lecture notes in epistemology of computer science and computer ethics in advanced educational settings, which is different from the traditional approach in distance education. We have seen that the integration with a Learning Management System (LMS) is possible, but there are some drawbacks in choosing a client-only web application. First of all, we were forced to duplicate some information between the diverse TiddlyWiki files. In particular, we decided to duplicate references to avoid inconsistency. In fact, in the original word processor version references were not made by chapter – roughly corresponding to modules – as were cited in different chapters. Moreover, it's not clear how to integrate the slides presented during lectures, which were made in PowerPoint or in Latex/PDF. It's possible to convert both formats to standard HTML files, but it's not possible to convert them directly to the TiddlyWiki format. We are currently exploring the use of S5 (http://meyerweb.com/eric/tools/s5/), a slide show format made only by web standards – i.e. XHTML, CSS and Javascript.

Last but not least, our current project is to find a simple way to perform continuos integration of students' annotation. It is possible we will have to start a companion course site with a collaborative wiki engine similar to TiddlyWiki (e.g. LesserWiki, http://www.lesserwiki.org) in order to let our students share their study paths. We want to retain the simplicity of use underlying TiddlyWiki, in particular the ease of making personal study versions of the lecture notes.

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