OPEN SOURCE SOFTWARE FOR E-LEARNING: LESSONS LEARNED FROM A THREE YEAR APPLICATION OF A CONTENT, COMMUNITY, AND COLLABORATIVE MANAGEMENT SYSTEM IN A PRIMARY SCHOOL IN GREECE

Ilias Karasavvidis

ABSTRACT
This paper focuses on the use of open source content management systems in primary education. The first part of the paper addresses the issue of open source software and examines recent international, European, and national initiatives regarding open source content management systems. The second part of the paper distinguishes two types of content management systems: specialized educational focus and general purpose systems. The organization and structure of PostNuke, a popular content, community and collaborative management system, is presented in the third part of the paper. The fourth part provides an outline of the main teaching and learning uses of PostNuke at a primary school in Crete over a period of three years. In the final section, the lessons learned from the educational application of PostNuke are discussed and the future prospects of using open source content management systems in education are addressed.

KEYWORDS
Open Source Software, Open Source Content Management Systems, PostNuke, on-line teaching and learning, educational projects, environmental education, electronic newspaper

INTRODUCTION

The potential of Information and Communication Technologies (ICT) to support new, more meaningful and student-centered forms of learning is widely recognized. The new e-learning paradigm appears to be one of the most promising realizations of this ICT potential. A primary condition for the realization of e-learning is the use of appropriate technological tools. In addition to the standard hardware and networking expenditures, the realization of e-learning also requires the use of specific software, either proprietary or open source. The present study focuses on Open source software (OSS) for supporting on-line teaching and learning.

Over the past few years Open Source Software (OSS) has gained considerable momentum and widespread acceptance (c.f. O'Reilly, 1999; Moore, 2002; Goetz, 2003;). On an international level, two major trends can be identified within this movement: open source software development and open source content development. Regarding the former, recent developments include the Open Knowledge Initiative (OKI) while with respect to the latter, MIT's OpenCourseWare (OCW) project and MERLOT represent major trends.

On the European Union level, OSS has attracted much attention which led to the recent funding of similar projects, both open source content (e.g. Learning Objects, LOs) and open source software (platforms, systems and standards) (Vuorikari, 2004a). More specifically, EU initiatives include projects such as ARIADNE, CELEBRATE, European Treasury Browser, LearningFolders.net, and etwinning (see table 1 for details). Moreover, the EU endorses the use of OSS in education and addressed this need through two main projects, SIGOSSEE and JOIN. The former aims to evaluate the relevance and opportunities afforded by OSS for the European educational community while the latter is geared towards providing support for organizations/institutions that plan to employ Open Source Learning Management Systems (OSLMS).

This interest in using OSS by European institutions/organizations/schools is reflected in a recent European-wide survey (European SchoolNet, 2003). Even though not fully reliable due to the sampling procedures followed, the survey shows that about two thirds of the respondent schools use either an in-house or open source virtual learning environment. In particular, open source environments represented 15% of the respondent primary and secondary schools. On the other hand, proprietary systems represent about one third of virtual learning environments used. In-house environments are virtual learning environments developed by national, regional or local authorities, universities and schools themselves. Overall, the study findings suggest that there is an interest in developing either custom or using and adapting open source solutions for e-learning. As is discussed in the report, the popularity of in-house and open source products may on the one hand lie in the fact that proprietary products are far too rigid and expensive for most educational institutions, primary and secondary schools. On the other hand, educational institutions seem to prefer to use products which can be tailored to their exact needs and over which they can have full control (c.f. European SchoolNet, 2003 for more details).

Table 1. Overview of international and European projects/initiatives on Open Source Software

Project/Initiative	Description	URL
Open Knowledge Initiative (OKI)	Development of specifications for components of educational software environments and standards for learning technologies	http://www.okiproject.org
OpenCourseWare (OCW)	All course materials are released to the public	http://ocw.mit.edu
MERLOT	Development and sharing of Learning Objects	http://www.merlot.org
ARIADNE	Development of learning tools, objects, and methodologies	http://www.ariadne-eu.org
CELEBRATE	design and use of collaborative and interoperable Learning Objects in integrated learning environments	http://celebrate.eun.org
European Treasury Browser	Learning resources repository	http://etb.eun.org/etb/index.html
LearningFolders	development of both educational content and an e-learning software platform	http://lefo.net
Etwinning	Strengthen and develop networking among EU schools	http://www.etwinning.net
SIGOSSEE	Evaluate the potential of Open Source Software for education	http://www.ossite.org

Virtual Learning Environments

From a historical point of view, e-learning systems are derived from groupware software, which falls into the category of Computer Supported Collaborative Work (CSCW). These systems afford both the communication (synchronous & asynchronous) and the collaboration (shared virtual spaces, file sharing etc), among users. As the term e-learning is both generic and broad, referring to a wide range of on-line teaching and learning activities, e-learning systems are can be of many types: Content Management Systems (CMS), Course Management Systems (CMS), Learning Management Systems (LMS), Learning Content Management Systems (LCMS), Knowledge Management Systems (KMS). Given that (a) the primary emphasis of each system may vary greatly in important respects and (b) there is a lack of precision in the definitions of what each type includes or not, it is important to bear in mind what all the systems share, i.e. they refer to on-line learning systems which constitute Virtual Learning Environments (VLEs). In this study we mainly focus on Open Source Content Management Systems (OSCMS).

Open Source CMS

Open Source Software Content Management (OSSCM) can be distinguished in two major categories: Content Management Frameworks (CMF) and Content Management Systems (CMS). The first category includes frameworks such as the Apache Cocoon project or Zope (written in Python). The second category includes systems such as PostNuke, phpNuke, openCMS, Typo3, Claroline, and Ilias to mention a few (see table 2). There are currently (Jan 05) well over 1000 open source web content/learning/course management systems registered with sourceforge (http://sourceforge.net), the largest repository of open source code and applications available on the web. Even though the majority of these projects are in early planning or development stages unavailable for testing or production purposes, there are about 200 hundred such mature web applications suitable for most purposes. Each OSCMS has its pros and cons depending on what one is looking for (i.e. course management and delivery over security or usability).

CMS: AN EDUCATIONAL OUTLOOK

From an educational perspective, CMS can be distinguished into two broad categories: (a) specialized systems which have a distinctive educational focus and (b) general purpose systems.

Specialized CMS/Educational focus

Whether OSS or proprietary, these applications were specifically designed for educational purposes and are built on the basis of various pedagogical design principles, supporting among others the creation of online communities as well as collaborative learning. Examples of such applications are CSILE-WebKF (proprietary; see Scardamalia & Bereiter, 1994), Synergeia (freeware but no source code provided; see Applet et al., 2002), Fle3 (open source; see Leimonen et al., 2003), LINE-DIMSS (freeware but not open source; see Mooij 2002; 2004; Mooij & Comber, 2004), WISE (no software provided, free to use web-based application; Linn et al., 2003), KIE (custom software is freeware but commercial software is also included; Linn et al., 1998), Belvedere (open source; see Suthers et al., 1997) and Co-VIS (proprietary; see Gomez et al., 1998). These systems are specialized in the sense that they have been developed with pedagogical objectives in mind so as to support collaborative learning and shared collaborative virtual spaces through appropriate tools. Software environments such as Synergeia/Fle3 or CSILE are based on specifically designed tools which support the cognitive processes of students in a variety of ways (Lipponen, 2001; Dimitrakopoulou & Petrou, in press). In addition to their pedagogical design, these tools are also founded on a conception of learning which is realized through working with the software (e.g. knowledge building (Scardamalia & Bereiter, 1994; progressive inquiry Hakarainen et al., 2001b).

General Purpose CMS/No educational focus

These applications essentially constitute Content, Community, and Collaborative Management Systems (C3MS). Due to their history, these systems are more oriented towards the support of collaborative communication and work amongst groups of users. These systems are general purpose tools which were not

in principle built to optimally facilitate collaborative learning from a pedagogical perspective. Given the lack of pedagogical design and the availability of OSCMS with an educational focus described above, one may wonder if general purpose tools present any interest to educators whatsoever. It is suggested that this lack of ad hoc pedagogical design not be perceived of as a disadvantage for three main reasons.

First, it is beyond doubt that the specialized software applications mentioned above (such as Synergeia or CSILE-WebKF) present many comparative advantages over general purpose applications regarding their educational design and significance. It has been argued that the design of such systems always involves several pedagogical compromises (Dimitracopoulou & Petrou, in press). Moreover, the pedagogical usability (Hakkarainen et al., 2001a) represents only one dimension of their pedagogical effectiveness – their actual use being the other major dimension. On a more cognitive level, it should be taken into consideration that the implicit belief that new technologies for collaborative learning de facto afford more advanced opportunities for collaborative learning and therefore are inherently better compared to existing technologies does not appear to be universally justified (Stevens 2002; Macay, 1999).

Second, even though the majority of OSCMS lack explicit pedagogical design (i.e. were not developed to address certain teaching and/or learning needs), some OSCMS have been built from scratch with a learning theory in mind, such as e.g. Moodle. Other general purpose OSCMS such as PostNuke also present educational interest owing to either a posteriori educational focus (e.g. edunuke) or the development of specific instructional and learning modules (TECFA SEED Project: Synteta, Schneider & Frété, 2002; Frété, Synteta & Schneider, 2002; Schneider, Synteta & Frété, 2002). In the remainder of this paper we examine on one such OSCOM, PostNuke, and discuss an application in an educational institution.

Third, as most of the OSCMS were developed to serve portal purposes web portals constitute the most widespread application of CMS today. Portals represent one of the most interesting developments in recent times compared to the first era of the web which was characterized by static pages. Portals structure user access to the information available on the web. Depending on their structure and purposes, portals are distinguished into horizontal and vertical. Portals have become very popular for specific services such as news and e-commerce. From an educational perspective, even though portals are widely adopted in the context of tertiary education, their dissemination in secondary and primary education has been limited. Moreover, research based on learning through portals in secondary and primary education has been scarce despite the possibilities afforded for their use in e-learning (Carmean & Haefner, 2002; SEED project: http://www.ilios.cti.gr/seed/). In this respect, portals might be a more appealing option for schools compared to a specialized software product, specifically designed for teaching and learning purposes.

Table 2: Open Source Content Management Frameworks and Systems

Content Management Framework/System	Description	URL
Apache Cocoon project	Framework written in Java	http://cocoon.apache.org
Zope	Framework written in Python	http://www.zope.org
Moodle	Specialized educational CMS which based on Papert's constructionist epistemology	http://www.moodle.org
PostNuke	Popular C3CMS	http://www.postnuke.com
edunuke	Focus on the development of educational modules for PostNuke	http://www.edunuke.org

OSCMS in the Greek context

In the Greek educational context OSCMS are becoming very popular as several portals use OSS solutions. Both governmental portals (such as the portal of the Pan-Hellenic School Network: http://www.sch.gr) and private or institution/organization portals (such as the Educational portal of South Aegean:

http://www.epyna.gr) rely on OSCMS solutions. Their use is due to (a) minimal cost (OSS under GNU GPL license), (b) the services offered, (c) reliability (continuously used for production purposes and evaluated by large communities of developers and users worldwide), and (d) the multiple opportunities for modifications, and customizations afforded by such systems. The PSN is an interesting example of a government educational organization which makes extensive use of OSS for most of the tools and services it provides. For instance, the asynchronous tele-education service offered by the PSN is based on Moodle which is, as mentioned earlier, a popular OSCMS developed with an educational focus offering the mechanisms for the creation and delivery of web based courses. Another example is e-class (http://eclass.gunet.gr), the asynchronous learning platform which was developed by the Greek Universities Network (GUN) and adapted from another popular OSCMS with an explicit educational focus, Claroline (http://www.claroline.net).

With respect to the use of portals in elementary education by Greek schools, there have recently been important developments. More specifically, up to 2004 the PSN basically offered schools (a) internet access services and (b) web hosting services. As a result, all the schools could do is upload static html pages to the PSN servers. As of 2004, the PSN provides more advanced services including dynamic html support as well, owing to the adoption of php and MySQL. Consequently, an even more important service is nowadays provided by the PSN: portal hosting. In principle, Greek schools nowadays are entitled not only to a website but also to a web portal. We find this to be a very significant development as each and every school can create and manage its own web portal without (a) hardware and software demands (given that all software is provided under GNU GPL license and can be customized to meet the needs of each particular school), and (b) networking costs (a leashed line for the web server to be continuously online is not required). Moreover, the technical aspects are easily handled, since school staff are relieved from most of the technical burdens of setting up web and database servers as well as installing, configuring and maintaining an OSCMS. PostNuke is among the OSCMS currently supported by PSN. In the remainder of this paper we examine PostNuke and present a 3-year educational implementation of the system in a Greek elementary school.

POSTNUKE

PostNuke is one of the most popular Open Source Content, Community and Collaborative Management Systems (C3MS) available on the web today. It can function as a news, communication and collaboration portal. The current stable version is 0.750 Gold.

Despite the fact that OSCMS are based on implementations of different open source technologies, the most common is known as LAMP, acronym of the technologies used: Linux, Apache, MySQL, and php. PostNuke is Operating System independent as it is written in an interpreted language though it is still based on Apache-php-MySQL. Historically, PostNuke is a phpNuke fork (http://www.phpnuke.org). PostNuke is a web application written in the scripting language php (http://www.php.net). It requires a web server (Apache: http://www.apache.org or IIS: http://www.microsoft.com) as well as the database server of MySQL (http://www.mysql.com). PostNuke is released under GNU GPL and can be used both for internet and intranet purposes. In terms of organization and structure, PostNuke has a modular design and is comprised of four different elements: (a) core, (b) themes, (c) modules, and (d) blocks.

Table 3. The structure of PostNuke 0.750

Component	Description
Core	Offers the main functionality of the system and its overall configuration
Themes	Allow the customization of the appearance of the system and include management of background colors, graphics, fonts, and general system layout. In the latest release (version 0.750) PostNuke is shipped with 7 different themes (skins), while several more themes are available from third parties and/or can be developed
Modules	Involve the services provided by the system and include: news, daily events, FAQs, polls & surveys, ratings, reviews, sections, topics, links etc. The current distribution of PostNuke (0.750) includes 45 modules all of which can be activated/deactivated. Moreover, any of the over 100 modules available from third parties free of charge could be installed and/or custom ones could be developed by drawing on the available API
Blocks	Structure the presentation of information to the system user, and regulate the user access to the system services. 15 blocks are included in the distribution of the 0.750 version of PostNuke while any of the several others available could be used and/or custom ones could be developed

USES OF POSTNUKE AT THE 6TH PRIMARY SCHOOL OF RETHIMNO

Information Lab

The current report is based on data collected by the author over a three year period (2001-04) during a series of design experiments carried out at the 6th Primary School of Rethimno, in Crete, Greece (http://6dim-rethymn.reth.sch.gr). These experiments were conducted in the school Informatics Lab which was established in 1999 and was equipped with 1 server and 13 workstations. The PSN was the internet access service provider for the school initially through a leased-line 128 Kbps connection (2001-03) and subsequently through a wireless 2 Mbps connection (2003-present). Due to (a) the server's real static IP address and (b) the resilient always-on connection to the internet, the server could also function as a web server.

PostNuke Installation & Modification

The Apache and MySQL servers as well as the scripting language php were installed and configured on the lab server running Microsoft Windows NT. PostNuke was installed on the web server in the beginning of the school year of 2001-02 (version 0.712 Rogue) for testing and development purposes only. The portal went public in April 2002 using the same PostNuke version. More than a year later, in July 2003, PostNuke was updated to version 0.726 (Phoenix) which in turn is scheduled to be updated to the current stable release (0.750 Gold) in the near future.

A general purpose web application like PostNuke requires the systematic adaptation and modification to the specific school needs in order to be usable for students and educators. Given the fact that the distributed release is not directly usable for educational purposes, several modifications and adaptations were made. These modifications were realized in two different time frames: (a) 2001-03 and (b) 2003-04.

The first phase of modifications involved the following: (a) language (translation of language files – both corrections to the system general language translation and the translations of several modules for which were no available language translations); (b) messaging system for asynchronous discussion (the lack of a reliable and usable forum at the time led to the adaptation of the news module to support threaded discussions), and (c) file sharing (file upload & download – adapting a third party module for uploading and downloading files). One of the themes included in the distribution was customized to meet the school needs. In addition to the activation of several services, content developed in the context of various school projects was also added to the portal.

The second phase of adaptations included the following: (a) customization of a theme (rman2) not included in the standard 0.726 release; (b) activation of several new services: calendar, calculator, guestbook, English version of the portal, English forum (xforum); (c) teaching and learning tools-services: modules for forum (phpBB2) and for creating static pages (Content Express). Moreover, two categories of content was also added to the portal: (a) school news and activities and (b) materials developed by students in the course of various school projects carried out through the portal. The final addition content-wise involved a set of research papers centered around the use of the portal itself for educational projects.
Even though OSCMS like PostNuke allow the creation of on-line communities by following open user-registration procedures (i.e. any interested user may register with the system), it was decided to disallow users to register. As control over what is posted by students was a primary concern, it was our intention to keep user registration under full control and, as a consequence, all system individual user and group accounts were issued by the author (for a detailed account of all system modifications see Karasavvidis, 2003).

Educational Projects
The portal supported several ICT teaching and learning activities over a period of three years (2001-04). At the movement of writing the portal has had over 150.000 page views, most of which were from system users over the course of these years. More specifically, the portal was used by 473 students for seven collaborative learning projects while it also hosted the work of 231 students. The rationale which guided the design of the projects was to develop appropriate practices (activities and tasks) for Computer-Supported Collaborative Learning (CSCL). Provided that CSCL requires new forms of teaching and learning practices such as new tasks, activities, and instructional scenarios, there have been calls for the development of activities appropriate for CSCL practices. All projects were carried out by the author in a design-experiment fashion (Brown, 1992; Barab & Kirschner, 2001; Cobb et al., 2001). All the projects were carried out either by the author or in collaboration with other teachers, depending on the nature and the objectives of each project. As a rule, all projects lasted for a whole school year, covering a period spanning over approximately 35 weeks (i.e. from September to June). All projects were held once a week in typical 45'-50'sessions in the Informatics lab of either the 6th primary school of Rethimno or in the Informatics labs of the collaborating schools. All projects had an explicit ICT literacy focus, aiming to develop students' ICT skills and competencies (c.f. Karasavvidis & Malandrakis, 2003). A transparent approach was followed whereby ICT was instrumental for the performance of a task. The two major tasks designed were of cross-curricular nature: (a) neighborhood problems with an Environmental Education (EE) focus (Chronaki & Karasavvidis, 2004) and (b) electronic newspaper with a focus on collaborative text production (e-newspaper). A general overview of the projects is given in table 5.

Table 4. An overview of the educational projects carried out through the portal (N: number of participating students; G: grade).

Project	N	G	Portal Use	Description
Environment 2001-02	104	5 & 6	host student work	ICT literacy focus through a cross-curricular EE approach
Environment 2002-03	141	5 & 6	mediate the asynchronous communication and collaboration among student groups	ICT literacy focus through a cross-curricular EE approach; students from two Greek cities discussed electronically the environmental problems facing in their neighborhoods
Environment 2003-04	107	5 & 6	mediate the asynchronous communication and collaboration among student groups	ICT literacy focus through a cross-curricular EE approach; students from two Greek schools and one Greek-Cypriot school electronically discussed the environmental problems of their neighborhoods
Collaborative e-newspaper 2002-03	89	6	mediate the asynchronous communication and collaboration among student groups	ICT literacy focus through a cross-curricular electronic newspaper creation activity; students from two Greek primary schools collaborated to write articles for a common electronic newspaper
Collaborative e-newspaper 2003-04	136	6	mediate the asynchronous communication and collaboration among student groups	ICT literacy focus through a cross-curricular electronic newspaper creation activity; students from two Greek primary schools collaborated to write articles for a common electronic newspaper
e-newspaper 2002-03	49	6	host student work	ICT literacy focus through a cross-curricular electronic newspaper creation activity
e-newspaper 2003-04	78	6	host student work	ICT literacy focus through a cross-curricular electronic newspaper creation activity

DISCUSSION

Lessons learned from the educational uses of PostNuke

System issues. PostNuke turned out to be reliable, stable, and secure while it could handle several users without problems (10-15 student groups concurrently logged into and making use of the system). In fact, the only system limitations were essentially due to hardware and operating system limitations, as the PC hosting the system was an old wintel machine (Pentium III, 128 MB RAM, 8 GB HDD, running Microsoft Windows NT 4.0).

Technical usability. All projects conducted had ICT objectives which targeted the development of specific skills such as: logging in and out of the system, posting a message in the appropriate forum thread; responding to an existing message in a thread; uploading a file by attaching it to the post; downloading a file attached to a post; netiquette. These ICT objectives were met, and after the initial familiarization and practice students became competent users of the system. Students were for the most part capable of using the specific technology as it was easily customizable. Still, some issues remained a problem for some of the students, such as logging into the system and typing usernames and passwords using Latin characters. Nevertheless, the system could be improved in some respects, making it more student friendly. For instance, the forum may become more personal and lively by using the actual student pictures as opposed to avatars. Another option is to develop student-centered themes, i.e. use bright colors and play-like features.

Pedagogical usability. Even though the technical aspects and the system usability did not turn out to be a problem for the students, what was truly challenging was dealing with the tasks assigned at a cognitive level. While data analysis is still underway, preliminary results show that the collaborative learning tasks were found to be open, complex, and, overall, very demanding. Students reported that they have enjoyed them and were very enthusiastic about authentic communication as indicated by most of the evaluation surveys. Nevertheless, students found computer mediated communication and computer-supported collaborative learning to be difficult and very demanding, acknowledging communication problems on many different levels. Still, when it comes to performing the same task (i.e. collaboratively write articles for an electronic newspaper), the students seem to favor electronic communication and collaboration over distance and find it more interesting and appealing compared to face to face collaboration in class.

Personnel issues. The transition from the traditional classroom to the on-line classroom is a huge leap for most educators. Leaving the technical issues aside, there are many learning, organizational, and pedagogical issues involved. For example, CSCL is by and large incompatible with traditional approaches to learning which poses an important obstacle for educators willing to incorporate it into their teaching and learning. Our experience shows that a single educator per school might install PostNuke (or any OSCMS for that purpose) but that does neither suffice nor guarantee its persistent and comprehensive use in everyday classroom life. As the history of Educational Technology shows, the availability of a technology is a necessary but not a sufficient condition for its widespread adoption and use (Cuban, 1986; 2001). Even though three staff meetings were held at the school over a period of 16 months, introducing the system and its services, only one teacher used the system with his students on a daily basis (i.e. the author of this paper). Out of the 32 staff, only two educators expressed some interest in using the system: one in a teaching unit which involved gathering and analyzing information from the internet, and the other for updating the news section of the school portal. Both educators were ICT novices and found the system somewhat complicated, especially the interfaces for posting news, producing static html pages, and uploading files.

CONCLUDING REMARKS

OSCMS represent a significant development because desktop and network technologies converge on a single, multipurpose, client-server, web-based application. OSCMS can be easily adapted to meet most of the typical school website needs as well as provide a platform for on-line teaching and learning, such as CSCL, CMC, and international collaboration.

PostNuke appears to be very appealing as a portal solution precisely because it does not have an exclusive educational focus. In addition to the standard portal uses, with the activation of some specific modules PostNuke can also be used as a virtual learning environment: support teaching and learning on-line as well as help create and sustain student learning communities. It is argued here that a specialized e-learning system specifically designed for e-learning might be less tempting for teachers to use. The incorporation of a tool providing specialized e-learning services might be too much for teachers who are novice users of ICT. On the other hand, a general purpose tool such as a portal which provides typical web services (such as news, blogs, chat & forum, reviews, wikis etc) and is closer to the popular web culture, might pay off for introductory-familiarization purposes. Thus, portals can function as transitory, intermediate step toward the adoption of a more specialized learning technology. The fact that PostNuke can be used both as a portal and as an e-learning system makes it more preferable to other more education-tailored OSCMS such as Moodle or specifically designed systems such as Fle3-Synergeia.

While at first glance the situation with OSCMS appears to be very disorganized with many competing projects and little or no cooperation among them, it is precisely this diversity which makes OSS more efficient and effective in the long run. Ongoing developments on both the international and the European levels will lead to mature OSCMS and deliver OSS-OSCMS standards and products for educational use

(c.f. Vuorikari, 2004b). Nevertheless, while from a technical point of view there are such promising developments, it should be borne in mind that what is still needed is careful planning of future steps. This planning includes student teacher and in-service teacher training, restructuring curriculum to make it compatible with virtual learning, developing appropriate curriculum materials, tasks, and activities, best-practice scenarios etc. The future incorporation of e-learning systems in educational practice will only partly depend upon technical features of the systems themselves. The history of Educational Technology shows that the technocentric approach never took us very far learning-wise and therefore, in addition to the developments on the technological front, we should also focus on the actual teaching and learning needs.

In conclusion, OSS currently represents not only a low cost solution but also a workable, viable and much desired alternative. The new opportunities afforded by OSCMS for teaching and learning purposes remain largely unexplored and the present paper makes a small contribution to that direction.

ACKNOWLEDGEMENTS
I would like to thank Dr K. Pigounakis & G. Hoogterp for sharing ideas and exchanging experiences regarding OSCMS. I am indebted to the principal of the 6th primary school of the city of Rethimno, P. Valsamidis, for his committed support to the whole project. Finally, thanks are due to the students who participated into the educational projects all those years.

REFERENCES

Applet, W., Ruland, R., Skarmeta, A.FG. & Stahl, G. (2002). *Synergeia version 2 user manual*. ITCOLE project. Retrieved July 19, 2004 from: http://bscl.fit.fraunhofer.de/download/SynergeiaManual.pdf

Barab, S.A. & Kirschner, D. (2001). Guest editors' introduction: rethinking methodology in the learning sciences. *The Journal of The Learning Sciences*, vol. 10 (1&2), pp. 5-15.

Brown, A.L. (1992). Design experiments: theoretical and methodological challenges in creating complex interventions in classroom settings. *The Journal of The Learning Sciences*, vol. 2. no, 2, pp. 141-178.

Carmean, C. & Haefner, J. (2002). Mind over matter. Transforming course management systems into effective learning environments. *EDUCASE review*, November/December. Retrieved February 5, 2004 from: http://www.educause.edu/pub/er/

Cobb, P., Stephan, M., McClain, K. & Gravemeijer, K. (2001). Participating in classroom mathematical practices. *The Journal of The Learning Sciences*, vol. 10, no. 1-2, pp. 113-163.

Chronaki, A. & Karasavvidis, I. (2004). Young Children's Electronic Communication through Project-based Activity: Interpreting the pedagogical experience. *Paper presented at the European Conference on Educational Research*, Crete, Greece.

Cuban, L. (1986). *Teachers and machines. The classroom use of technology since 1920*. Teachers College Press.

Cuban, L. (2001). *Oversold and Underused: Computers in the Classroom.* Cambridge: Harvard University Press.

Dimitrakopoulou, A. & Petrou, A. (in press). Advanced collaborative distance learning systems for young students: design issues and current trends on new cognitive and metacognitive tools. *Themes in Education*.

European SchoolNet. (2003). Virtual learning environments for European schools: a survey and commentary. Retrieved January 17, 2005 from: http://www.eun.org/etb/vle/vle_report_restricted_2003.pdf

Frété. C., Synteta. P. & Schneider, D. (2002). Activity design: a catalogue of socio-constructivist learning activities. *TECFA::SEED Project. Working paper 11*. Retrieved March 8, 2003 from: http://tecfa.unige.ch/proj/seed/catalog/papers.html

Goetz, T. (2003). Open source everywhere. Wired, 11.11. Retrieved December 8, 2004 from: http://www.wired.com/wired/archive/11.11/opensource.html

Gomez, L.M., Fishman, B.J. & Pea, R.D. (1998). The CoVis project: building a large-scale science education testbed. *Interactive Learning Environments*, vol. 6, no. 1-2, pp. 59-92.

Hakkarainen, K., Lakkala, M., Rahikainen, M., & Seitamaa-Hakkarainen, P. (2001a). Conclusions - pedagogical guidelines for designing ITCOLE CSCL. In M. Lakkala, M. Rahikainen & K. Hakkarainen (Eds.), *Perspectives of CSCL in Europe: a review (pp. 84-96).* ITCOLE project deliverable D2.1. Retrieved July 19, 2004 from: http://www.euro-cscl.org/site/itcole/D2_1_review_of_cscl.pdf

Hakkarainen, K., Rahikainen, M., Lakkala, M., Lipponen, L. (2001b). Implementation of Progressive Inquiry in Finnish CSCL-settings. In M. Lakkala, M. Rahikainen, M., & K. Hakkarainen (Eds.). *Perspectives of CSCL in Europe: A Review (pp. 30-45).* ITCOLE project deliverable D2.1. Retrieved July 19, 2004 from: http://www.euro-cscl.org/site/itcole/D2_1_review_of_cscl.pdf

Karasavvidis, I. & Malandrakis, G. (2003). The impact of an Environmental Education based Informatics module on the attitudes of students in grades 5 and 6 towards the environment. In C.P. Constantinou & Z.C. Zacharia (Eds.). *Computer Based Learning In Science. Conference proceedings, Vol. 1* (pp. 771-780). Nicosia, Cyprus: Dept of Educational Sciences Publications.

Karasavvidis, I. (2003). E-learning: the system PostNuke 0.7x. In T. Triantafillidis, K. Chatzikyriakoy, P. Politis & A. Chronaki (Eds). *Proceedings of the 6th Pan-Hellenic conference on Teaching of Mathematics and Informatics in Education* (pp. 364-369). Athens: Gutenberg Publications [in Greek].

Leimonen, T., Kligyte, G., Toikkanen, T., Pietarila, J. & Dean, P. (2003). *Learning with collaborative software – a guide to Fle3*. Helsinki: Taideteollinen korkeakoulu. Retrieved July 19, 2004 from: http://fle3.uiah.fi/papers/fle3_guide.pdf

Linn, M.C., Bell, P. & Hsi, S. (1998). Using the internet to enhance student understanding of science: The Knowledge Integration Environment. *Interactive Learning Environments*, vol. 6, no. 1-2, pp. 4-38.

Linn, M.C., Clark, D. & Slotta, J.D. (2003). WISE design for knowledge integration. *Science Education*, 87, pp. 517-538.

Lipponen, L. (2001). Supporting collaboration with computers. In M. Lakkala, M. Rahikainen & K. Hakkarainen (Eds). *Perspectives of CSCL in Europe: a review (pp. 7-17).* ITCOLE project deliverable D2.1. Retrieved July 19, 2004 from: http://www.euro-cscl.org/site/itcole/D2_1_review_of_cscl.pdf

Mackay, W.E. (1999). Is paper safer? The role of paper flight strips in air traffic control. *ACM Transactions on Computer- Human Interaction*, vol. 6, no. 4, pp. 311-340.

Mooij, T. & Comber, C. (2004). Contextual learning theory and the design of software to optimize early education. *Paper presented at the European Conference on Educational Research (ECER)*, Crete, Greece.

Mooij, T. (2004). Optimizing ICT effectiveness in instruction and learning: multilevel transformation theory and a pilot project in secondary education. *Computers & Education*, vol. 42, pp. 25-44.

Mooij,T. (2002). Designing a digital instructional management system to optimize early education. *Educational Technology Research & Development*, 50(4),11–23.

Moore, A. H. (2002). Open source Learning. *EDUCASE Review*, September/October, pp. 42-51.

O'Reilly, T. (1999). Lessons from open-source software development, *Communications of the ACM*, vol. 42, no. 4, pp. 33-37.

Scardamalia, M., & Bereiter, C. (1994). Computer support for knowledge-building communities. *Journal of the Learning Sciences*, 3(3), 265-283.

Schneider, D. Synteta, P. & Frété. C. (2002). Community, Content and Collaboration Management Systems in Education: a new chance for socio-constructivist scenarios? In A. Dimitrakopoulou (Ed.). *Proceedings of the 3rd Pan-Hellenic ICT in Education conference, vol. 1* (pp. 175-184). Athens: Kastaniotis Inter@ctive publications.

Stevens, R.R. (2002). Divisions of labor in school and in the workplace: comparing computer-and paper-supported activities across settings. In T. Koschmann, R. Hall & N. Miyake (Eds.). *CSCL 2. Carrying forward the conversation* (pp. 229-258). Mahwah, NJ: Lawrence Erlbaum Associates.

Suthers, D.D., Toth, E.E. & Weiner, A. (1997). An Integrated Approach to Implementing Collaborative Inquiry in the Classroom. In R. Hall, N. Miyake, & N. Enyedy (Eds.). *Proceedings of CSCL 97: The second international conference on Computer Support for Collaborative Learning (* pp. 272-279). Toronto: University of Toronto Press.

Synteta. P. Schneider, D. & Frété. C. (2002). Activity software: C3MS bricks for socio-constructivist scenarios. *TECFA::SEED Project. Working paper 10*. Retrieved March 8, 2003 from: http://tecfa.unige.ch/proj/seed/catalog/papers.html

Vuorikari, R. (2004a). Methods for sharing open source content: the School Network's perspectives. *Didamatica 2004*, Ferrara, Italy. Retrieved January 10, 2005 from: http://insight.eun.org

Vuorikari, R. (2004b). Why Europe needs free and open source software and content in schools. Retrieved January 10, 2005 from:

http://www.eun.org/insight-pdf/special_reports/Why_Europe_needs_foss_Insight_2004.pdf

I. Karasavvidis
Assistant Professor
Department of Primary Teacher Education
School of Education
University of Crete
University Campus
Rethimno 74100
Crete, Greece
E-mail: ikaras@edc.uoc.gr