

# Moodle: Using Learning Communities to Create an Open Source Course Management System

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Abstract: This paper summarizes a PhD research project that has contributed towards the development of Moodle - a popular open-source course management system (moodle.org). In this project we applied theoretical perspectives such as "social constructionism" and "connected knowing" to the analysis of our own online classes as well as the growing learning community of other Moodle users. We used the mode of participatory action research, including techniques such as case studies, ethnography, learning environment surveys and design methodologies. This ongoing analysis is being used to guide the development of Moodle as a tool for improving processes within communities of reflective inquiry. At the time of writing (April 2003), Moodle has been translated into twenty-seven languages and is being used by many hundreds of educators around the world, including universities, schools and independent teachers.

# Introduction

The research described in this paper is a PhD research project conducted by the first author (Martin), with the help of the second author (Peter) at Curtin University of Technology. This project has been in progress for several years, and is due to be completed in the first half of 2003, however, the success of the Moodle software has already ensured that the processes of research and development described here will continue in the foreseeable future.

There are many research questions that we are trying to answer, with new ones emerging all the time, but the major question is: How can internet software successfully support social constructionist epistemologies of teaching and learning? More specifically, what web structures and interfaces encourage or hinder participants engagement in reflective dialogue within a community of learners - by reading openly, reflecting critically and writing constructively in a way that engages their personal experiences? We explain these terms in the next section.

Our aims in answering these questions are, firstly, to improve our own skills

at using the Internet to facilitate distance learning, secondly, to improve the pedagogical skills of other teachers by making our software tools freely available under an Open Source license, and thirdly, to facilitate a supportive community of software contributors. We hope this will help us improve the capabilities of the software for stimulating reflective practice in not only students, but also in teachers and developers like ourselves.

# Theoretical perspectives

The past few years have seen a marked increase in research around online learning and the use of educational technology. There are now more than 40 academic journals specialising in these topics. After the early years of forays into computer-mediated conferencing and Web-based learning (Amundsen 1993; Mason & Kaye 1989), it is becoming clear that pedagogical use of the Internet should be informed and appraised by clear theoretical perspectives.

### Online pedagogy

The most prevalent theoretical perspectives in research on online learning are those related to constructivism, particularly *social constructivism* and *social constructionism*. These epistemological positions privilege a focus on collaborative discourse (Amundsen 1993; Bonk & Cunningham 1998; Jonassen, Peck, & Wilson 1999) and the individual development of meaning through construction and sharing of texts and other social artefacts (Ernest 1995; Gergen 1995; Papert 1991) . From these perspectives, learners are apprenticed into "communities of practice" which embody certain beliefs and behaviours (Lave & Wenger 1991) .

The theory of 'ways of knowing', originally from the field of gender research (Belenky, Clinchy, Goldberger, & Tarule 1986) provided us with a framework to monitor the quality of discourse within a collaborative environment. It highlights the existence of two distinct learning styles: separate knowing and connected knowing. *Connected knowers* tend to learn cooperatively, and are more congenial and more willing to build on the ideas of others, while *separate knowers* tend to take a more critical and argumentative stance to learning. These styles are independent of intelligence or learning capacity, and independent of each other: each of us can may use both styles at different times (Galotti, Clinchy, Ainsworth, Lavin, & Mansfield 1999; Galotti, Reimer, & Drebus 2001) . In our online discourse we try to encourage students to engage as connected knowers in order that productive educative relationships are more readily established amongst the students.

We find Habermas' critical theory of *communicative action* (Habermas 1984) another useful way to think about discourse, in terms of *strategic* or *communicative* actions, and the intersubjectivity of the mutual

understanding of intentions. Likewise, his theory of emancipatory knowledge explains how *critical self-reflection* can lead to a transformation of perspective and realisations of how the horizons of one's professional ontology (or social reality) are shaped by historical, political and economic contingencies. Thus, our pedagogical intention to enable teachers to develop the skills of transformative professionals capable of appreciating the need to complexify the culture of learning in their own educational institutions so that the interests and aspirations of all students are met. Interwoven into this is the theory of *transformative learning* (Mezirow 1991), which call on educators to help the learner examine the assumptions that underlie their beliefs, feelings and actions, then assess the consequences of these assumptions, explore alternatives and test their validity through effective participation in reflective dialogue.

Interestingly, we have found almost no published research that explicitly encourages meaningful engagement of students in connected online dialogue as defined by these multiple referents. We intend to continue developing this theoretical framework while maintaining a critical self-reflective attitude towards our own pedagogical assumptions.

#### Research methodology

Our research in general employs an *interpretive research* methodology (Denzin & Lincoln 2000) in which we combine elements of *participatory action research* (Kemmis & McTaggart 2000), *virtual ethnography* (Hine 2000), and *software design* (Carter 1999). In order to optimise credibility and transferability, we use multiple data sources, prolonged engagement and member checks (Guba & Lincoln 1989). We proceed in an evolutionary manner, similar to Cook's (2001) approach of theorising about dialogical processes, in that we iteratively: (i) apply theory to software design; (ii) put design into practice; (iii) collect and analyse data; and then (iv) use the results to revise our theoretical perspective before embarking on the next study cycle. The results of this approach are evolving theory and evolving software.

We monitor key aspects of the online learning environment throughout the courses using two survey instruments. The Constructivist On-Line Learning Environment Survey (COLLES) was designed to help teachers assess, from a social constructivist perspective, the quality of their online learning environment (Taylor & Maor 2000) by obtaining convenient measures of students' perceptions and preferences. The instrument exists in two forms (actual, preferred), and each form consists of 24 questions arranged into 6 scales:

- 1. **Relevance** how relevant is online learning to students' professional practices?
- 2. **Reflection** does on-line learning stimulate students' critical reflective

- thinking?
- 3. **Interactivity** to what extent do students engage online in rich educative dialogue?
- 4. **Tutor Support** how well do tutors enable students to participate in online learning?
- 5. **Peer Support** do fellow students provide sensitive and encouraging support?
- 6. **Interpretation** do students and tutors make good sense of each other's communications?

The other survey instrument we find helpful in evaluating students throughout a course is the Attitudes Towards Thinking and Learning Survey (ATTLS), developed by Galotti et al. (1999). ATTLS helps to measure the extent to which a person is a 'connected knower' or a 'separate knower'. This survey, like the COLLES, has been integrated into Moodle as part of a generic survey module that automatically provides easy-to-read graphs and charts.

#### Software design

Moodle has been designed to be compatible, flexible and easy to modify. It has been written using the popular and powerful PHP language, which runs on any computer platform with a minimum of effort, allowing teachers to set up their own servers using their desktop machines. Moodle is built in a highly modular fashion and uses common technologies such as shared libraries, abstraction, and Cascading Style Sheets to define the interfaces (while still working on old browser technology). Originally this approach was adopted so that Martin could rapidly create or modify interfaces in response to our analysis and research interests, but now it is enabling other programmers (even novices) to modify and expand the code. Moodle can be linked to other systems such as mail servers or student directories. Recent directions include a further separation of the interface from the code (using XML with XSL transformations) allowing the interface to be defined almost completely independently of the logic and storage.

# Analysing our own teaching

To examine our own teaching with Moodle we used a four-month course (known locally as a "unit") called "Constructivism" that Peter teaches annually for teachers engaged in professional development through distance learning. The defined learning goals for students of the unit were:

- 1. to learn about constructivism,
- 2. to reflect critically on their own learning, and
- 3. to learn collaboratively by engaging others thoughtfully and empathically.

The unit was conducted using Moodle in two successive years (2001 and 2002) using successive, evolving prototypes. Peter constructed the websites as a teacher-researcher using Moodle as a tool which Martin (as developer/researcher) modified according to need. From the set-up stages through to the end of the units, our research included critical self-reflection on the use of Moodle as a tool to construct and conduct online courses. While examining and interpreting student case studies we focus on elements of the students' learning environment that are at least partially within our control. These include:

- 1. the web site as a tool for navigating the course,
- 2. the web site content, activities and resources,
- 3. the online tutor's participation and support, and
- 4. the students' participation and support.

Of course there are other elements of the students' environment that are beyond our direct control, nevertheless we recognise these as important to understanding the whole learning experience of a student. These include:

- 1. the students' predispositions (to internet, distance education, authority, constructivism, etc.),
- 2. the professional cultures they are part of,
- 3. the environmental conditions at the place they access the web site,
- 4. the hardware and operating system they are using,
- 5. the quality of their connection to the web site (availability, bandwidth), and
- 6. the context of this course within the student's overall course of study.

#### The first year

The eight students generated a large amount of data during the 14-week unit. Apart from the survey data, about 150,000 words were written in the online journals and forums, and about 20,000 log entries were recorded (each entry denoting an "action" taken by a participant).

#### **Outcomes**

At the end of the unit, our judgement (as teacher-researchers) was that the unit was relatively successful (compared with the print-and-post version) inasmuch as nearly all students who completed the unit satisfactorily achieved the three learning goals. This assessment was based on our experiences of teaching the unit and monitoring student interactions, as well as on statements made by students in journal entries, essays and informal (email) exchanges with us.

The quantitative data provided an interesting overview of students' perceptions. The ATTLS scores indicated that almost all students had scored relatively highly as "connected knowers", and our experiences in the

discussion room seemed to confirm this - most of the time nearly all students had exhibited adequate empathy and avoided adversarial stances. Likewise, the COLLES results indicated that all students had experienced close to an optimal learning environment on four of the six scales: their preferred scores were usually only marginally higher than their actual scores. However, the relatively low COLLES scores indicated for the *interactivity* and *peer support* scales raised some questions. Given that our students had scored highly as "connected knowers", and that the collaborative goal of the course was worth 60% of the total assessment, we wondered why the students seemed to prefer a relatively low frequency of interactivity and peer support. To answer this question we looked closely at the quality of interactions through dialogue, and in particular investigated the experiences of particular students.

When we analysed the discussions we found, overall, that students had tended to engage in serial monologues rather than in rich dialogue. We surmised that there were probably two contributing factors. The first was the time-restrictive format of the unit, which had overemphasised the importance of individual reflective thinking, particularly the initial journaling activity, and had not placed enough importance on subsequent reflective dialogue. Many students had tended to post portions of their journals as their initial discussion contribution, thereby establishing a largely monological stance that did not directly invite others into a conversation. This approach indicated that we had not clearly differentiated between the journaling and discussion activities.

Second, because the teacher (Peter) had not wanted to dominate the online forum he had tended to silence his own voice in favour of allowing the students to develop and exercise their own online voices, and thus had not adequately modelled reflective dialogue. As a result, Peter had tended not to develop strong educative relationships with the students. He was more of an outsider looking in, providing occasional prompts and contributions, but leaving the students to deal with one another in accordance with the rules of discourse. Most of his interactions with the students occurred in the context of assessing their journal entries.

It seemed clear that we needed to further reduce the emphasis on individualized learning and increase the emphasis on engagement in reflective dialogue. We realised this could be achieved structurally, through modifications to the format of the unit and the instructional activities, as well as to Moodle. And we realized also that Peter needed to become more engaged in facilitating and moderating dialogue, by adopting a more interactive role similar to his role in on-campus classes; where he alternated (mostly spontaneously) between prompting and managing discussion and clarifying and extending students' conceptual development. He achieved this by drawing on a repertoire of learning-centred teaching skills which include reading students' body language, playing devil's advocate, using the white-board for illustrating visually relationships

between ideas, and knowing when to change the teaching focus from the whole group to the individual student.

### The second year

In the 2002 version of the unit, we decided to increase teaching flexibility and achieve a better balance between individual reflection and online discussion. Thus, we broke out of the weekly format into a format based on (2- or 3-week) topics.

For each topic students were required to read two (sometimes three) papers and make journal entries; except that now they were given a whole week for this individual activity and the focus was more on conceptual development of key ideas. Reflecting on professional implications was reserved as the main subject of the subsequent discussion forums. In these forums (held over 1-2 weeks), students were required, as before, to initiate a discussion (thread) with a message in which they reflected on the current topic, only now they were required to consider implications for their own professional practice. Because of the relatively small number of online students (only 3), we encouraged everyone to respond to each of the others' stories and issues in ways that helped the original poster reflect on their professional practice. Each topic also included a COLLES (overall there were twice as many surveys as the previous year, which we think also helped to promote the ideas contained in the questions). Finally, the last topic included a short quiz (not for assessment), which asked students to identify a number of trivia questions from the forums. A new forum search engine provided an easy way to find these answers while encouraging some revision of the discussions from throughout the unit.

We tried a variety of ways to better model connected behaviour in the online social environment. Not only were we ourselves trying harder when posting in the forums and interacting with everyone, but we also modified Moodle with a variety of mechanisms to help promote this behaviour:

- 1. Prompts were provided at the point of writing that stimulated students to think about Socratic questioning, empathy and other features of connected dialogue.
- 2. Tools for peer-rating were added to the forums, allowing us all to rate each post on a scale ranging between "Shows mostly connected knowing" and "Shows mostly separate knowing".
- 3. A library of emoticons and a WYSIWYG editor (allowing fonts, colours, layout) were added during the course which considerably enhanced the possibly of adding rich 'body language' (aesthetics and emotions) to posts, especially in the online forum.
- 4. A new forum structure that helped focus each discussion on the initial reflective post from each student.
- 5. A new display on the front page of the course showing the new posts

(and other recent activity) that had taken place since the last login.

#### **Outcomes**

At the time of writing we are still analysing the data from this year, but preliminary results indicate that overall the students engaged in a highly dialogical relationship with each other and with us - the improvement in quality of online dialogue compared with the previous year was very noticeable.

Of particular significance was the sharing amongst students of their unique curricular experiences, which provided stimulating contexts for discussing the prospects and problems of applying the concepts developed during the initial journaling activity. Also notable was the heightened sense of accountability amongst the students for ensuring that they engaged one another in mutually productive dialogue. Important indicators were students' raising of questions to stimulate each others' thinking (rather than only providing their opinions), increasing willingness to disclose their uncertainty about particular concepts and a tendency to seek assistance from each other.

Another positive outcome was the enhanced educative relationship between Peter and the students. Based on his close reading of students' journals, Peter kick started discussions by posing carefully crafted questions designed to engage students in deeper conceptual development, and during the discussions Peter actively moderated the discussions as he strategically posed further queries and dilemmas and advanced organisers linked to the forthcoming topic. As the weeks passed, Peter was able to sense students' emerging interests in the subject matter, and began to offer options to the students for subsequent readings and offered advice on the focus of their final assignments. Peter felt that his educative relationship with these students was very comparable with the best relationships he fostered in his on-campus classes. The occasional exchange of candid digital images between Peter and students injected humour and promoted a helpful degree of informality.

These observations, as well the formal analysis still underway, have provided (and will continue to provide) a basis for further development of pedagogical support within the Open Source version of Moodle. For example, our experiences with successful moderation practices will lead to more formal software support of moderation skills within online discussions (Brookfield & Preskill 1999; Collison, Elbaum, Haavind, & Tinker 2000; Gilly 2000; Palloff & Pratt 1999).

# **Building an Open Source community**

A rapidly growing force in the software world is that of Open Source

Software (OSS), where the ownership and use of the software is governed by an Open Source license (Perens 1997) such as the popular GNU Public License (GPL). Unlike typical commercial software, OSS licenses explicitly allow anybody to freely use, modify, redistribute and even sell the software under the condition that the open source license is maintained. In general this means that user modifications are absorbed into the main software project, and so the software evolves to embody the values of user community, even as that community itself evolves. This type of system has already proven very successful in developing much of the basic software that makes the Internet possible (Linux, Apache, Bind and Sendmail are among the most well-known examples of the thousands that exist).

## Starting the Moodle community

The methods of successful open source development efforts vary somewhat depending on the type of software and the individuals involved. OSS methodologies are a new field more akin to a craft, and very little formal research exists at all (FLOSS 2002), and almost none for OSS in education. As part of this project, I (Martin) have been researching the methodologies employed by a large number of open source projects - formal and informal - by observing and participating in their development communities. The active ones are true learning communities, with members teaching each other how to install, use, and extend the product, while collaborating on the design of new features. Over several years I have noticed certain features of the projects that seem to attract and maintain such learning communities, and applied this experience in setting up the environment for the Moodle community (moodle.org). Some of the necessary features are:

- A clear, obvious web site design (and web address, like moodle.org)
- Demonstrations of the software that are easy to get into
- Simple but extensive documentation for developers and users
- Structured, easy-to-use forums and mail lists for different purposes (support, discussion, suggestions)
- A central transparent place to safely store all source code (a CVS server)
- A tracker to keep track of issues (e.g. bugs, new features) and their status

It is also important to advertise a project; otherwise no one will find it. The best way to do this is to list the project on the wide variety of software directories on the Internet, which often include short reviews and user ratings. A large number of links to the site from many other sites not only increases the chances of people stumbling on to the site, but also improves the ranking of the site in search engine results. It takes time (many months of maintaining links) but a critical mass of links will eventually cause others to post the link as part of web forums, email lists, bookmarks, magazine reviews and so on and the project will start to become established as a

fixture on the Internet. Statistics and web server logs show that these techniques have worked well so far for moodle.org.

### Growing the Moodle community

Now <u>moodle.org</u> is operational, I try to model professional behaviour that is consistently *constructive* and *connected*. My guidelines are grounded in the experiences from our Constructivism courses, as well as ongoing study of the behaviours that seem to be successfully helping the Moodle community grow and develop:

- I release software "early and often" (Raymond 1999), so that even non-developer users can feel more a part of the development process and new bugs can be caught more quickly.
- I respond to email and forum posts as quickly as I can. Not only does it help encourage people to communicate, it gives more life to the site as it's always changing with new content.
- I try to be as friendly and helpful as possible at all times, even when it's tempting to flame someone. Negative posts become a permanent part of the site and can dampen further interaction between people.
- I try to be particularly supportive to contributors. With encouragement, some people can really blossom. If their interest is stimulated, some people feel more able to make larger contributions.
- I continually evaluate the learning environment and make changes as necessary, evolving in a way that brings the user along on an adventure
- I look for links and publish them (e.g. between discussions, or finding people who could help each other, or to websites/resources). As the site and community grows, this reduces the distances people have to travel to connect with the information they are looking for.

Putting this sort of energy into <u>moodle.org</u> is one factor that "keeps the pot bubbling", so that people are having fun, adding their own ideas and becoming engaged in helping the development. The structure of Moodle lends itself to this. The forums are quite easy to get into, and once one has posted they keep drawing one back in to the web site via email. The large diversity of other people on the site is starting to become an attraction in itself.

A large advantage of focussing on <u>moodle.org</u> as a learning community (and using Moodle to run it) is that participants (who are normally administrators and teachers) are able to experience Moodle from a student's perspective, and learn about online learning from their fellow participants. If the behaviour I am modelling at <u>moodle.org</u> (with it's theoretical background of social constructionism, connected knowing and transformative learning) is effective, it can potentially transform participants and so affect the teaching behaviour within their own Moodle installations. Early evidence

from the postings of some participants suggests that this is occurring:

"I am learning a tremendous amount about how to structure classes from your work. [...] As I write out more documentation on what I'm learning I'll post it here. " - A

"I can only say one thing about Moodle "teachers love it". ... I have placed this software in the hands of a few teachers... all I can say they don't want to wait to have it fully tested. They just want to start using it in their classroom ... I am referring to regular teachers in the areas of social studies, science, language arts even math. The way information it's delivered, paper work reduce, information can be view anywhere, accessibility it's the way they want it... - B

"I think you are really onto a winner here, at least from an educational perspective. I have introduced Moodle to other staff and students at the school. The potential is enormous and we have already discussed ways to expand its use. Keep up this fantastic work!" - C

"We have been using Moodle for a couple of weeks now, and I have to tell you that all the interactions in my class have improved greatly in that time. It's a much better class than it was." - D

# Moodle, now and the future

This paper has outlined a methodology used to construct an Open Source course management system grounded in research from the fields of education and Internet software development. The system is already proving quite successful and a continuation of these strategies is planned, along with further research into their effectiveness. Future research and development will include:

- Even stronger pedagogical support for students and teachers in all areas,
- A wider range of activities, such as role-playing simulations and group projects,
- Expansion of the role of <u>moodle.org</u> to support teachers using Moodle, and
- Examining options for making Moodle economically self-sustainable as an open-source company, such as optional paid services including professional support, customisation or personal consulting.

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# Visitor comments:

From: jlwatt, jlwatt@houston.rr.com

Date: Fri, 15 Aug 2003, 11:30

Great paper! I am currently working on my master's (hopefully eventually my PhD) in instructional design for online learning. I am also in the process of starting a training business using Moodle. I also am learning PHP and researching Learning Object standards. I am looking forward to your SCORM compliance. I created an ASP app that will put courses in a Microsoft LRN format. One of these days I am going to teach myself PHP and see if I can't get Moodle to import them!:) Thanks for this site and expect to hear more from me!

From: Erick Brito, erbrito@saludnet.com.mx

**Date:** Fri, 5 Sep 2003, 02:38

I just become to know moodle, I have instaled in my machine and I find an excelent way to build a net of knowdlege. I bealive that e-learning could open the way of working. The colaboration at work could be closer to the academycs centers. Whith a big impact in productivity. Congratulations for all the work done that reflect moodle and this paper. Erick (sorry for my English, my first language is Spanish, I alsa speak in frensh)

From: Charles Libby, cslibby@latn.dyndns.org

**Date:** Wed, 10 Sep 2003, 02:44

This paper has really been an encouragement to me as I start my Masters in Education with an emphasis on Distance Learning. I hope I can pick up some more on PHP and aid in contributing to the overall program. I hope we can enhance the educational sector with excelent and inexpensive learning tools such as Moodle. Now we just need to surplant Authorware.

From: Karel Kveton, vformanova@mbox.dkm.cz

**Date:** Mon, 17 Nov 2003, 16:17

Nice paper! I just started with Moodle. My first impression is very good. Thanks for excellent work and expect to hear from me again! (Prague, Czech Republic).

From:,

Date: Thu, 4 Dec 2003, 20:24

yes

From: Steve Adcock, Steve.Adcock@det.wa.edu.au

**Date:** Mon, 1 Mar 2004, 15:36

Myself and a lot of people are really greatful for what you have done and are trying to implement it. An area that I am focussing on is a tool development to suit pedagogical

and knowledge needs. I tried moodle in a school situation (~12 months ago)with some success but I am about to relaunch it with a different approach. I have time this year to work on the above tool i mentioned and may look to adding it to you development area to try and get it working.

From: Rodolfo Orjuela S., rorjuela@uni.pedagogica.edu.co

Date: Fri, 28 May 2004, 02:50

What version of postgres works very well on moodle 1.1.3?

From: John Pederson, john.pederson@pedersondesigns.com

Date: Mon, 5 Jul 2004, 08:14

Martin & Peter... Incredible. I first tried Moodle two days ago to kill a bit of time on a quiet Friday at work. I'm in charge of technology for a medium sized K12 school district. After two hours with the product, I felt something "different" about the software. Without exaggerating, it was the same feeling I had a)when "netscape" was released, and b)when I first found an email client that supported attachments. Finally, a software tool that does for teaching/learning what Netscape and email clients did for the Internet. I was hooked further after reading about "social constructivist pedagogy". To find that there were "education" brains behind the whole thing was truly inspiring. Keep pushing. Thanks for giving me what I've been looking for all these years.

From: Chandler Powell, powellc@newbernpd.org

**Date:** Wed, 16 Mar 2005, 02:15

I really enjoyed your paper. The New Bern Police Department recently decided to use the on line Moodle Black Board system. Please advise if you are aware of a Moodle workshop or Training that I can attend to administer the program for our agency.

From: CARLOS MILLAN, millanmarketing@yahoo.com

Date: Sat, 9 Apr 2005, 03:29

THANKS FOR SHARING YOUR IDEAS.

From: Emanuel Moyo, moyoct14@yahoo.com

Date: Tue, 4 Apr 2006, 02:18

Moodle is, indeed, a phenomenal invention! I'm currently working on my master's degree in Educational Technology. I was only familiar with Blackboard being the Learning system used in my school (Univ. Of Luton, UK). I became fascinated upon discovering moodle, and its open source nature makes it absolutely attractive as the key aim of my work is its deployment in developing countries like Nigeria. Thumbs up for you guys for doing a great job, and hope to see you in Milton Keynes in July. Meanwhile, can you please advise if there's any training i can attend so as to become a very good administrator of this "class act" called Moodle?

From: marlene, marlene@uci.cu Date: Fri, 7 Apr 2006, 21:42

I am currently working Moodle is very good, Is a excelent learning tool  $\dots$ I begening use

in University, Cuba, thanks

Further comments disabled due to spam.