# Using social web tools for knowledge construction

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**Abstract:** This paper examines knowledge construction in a distributed learning environment supported by social web tools. Research data was gathered from online asynchronous discussions in a first-year masters degree course in multimedia in education. Our analysis was modelled on Gunawardena et al.'s (1997) study and results indicate that, despite a significant percentage in the phase of sharing and comparing information, interaction at the highest levels of knowledge construction is relevant and suggests that knowledge was constructed.

**Keywords:** social web; knowledge construction; interaction analysis.

**Reference** to this paper should be made as follows: Lucas, M. and Moreira, A. (2011) 'Using social web tools for knowledge construction', *Int. J. Technology Enhanced Learning*, Vol. 3, No. 2, pp.151–161.

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## 1 Introduction

Recent reports and guidelines (Altbach et al., 2009; OECD, 2009; European Commission, 2007) have been recommending the adoption and the integration of communication technologies (CT) as a means to offer flexible, comprehensive and tailored learning opportunities to all individuals at all stages of their lives. As a result, the open and distance learning paradigm has been increasingly recognised and adopted as a requisite

for all educational systems that wish to assure the acquisition and development of lifelong learning skills by their students.

In the past few years, the evolution of the internet applications, now called social web or Web 2.0, has placed strong emphasis upon sharing, participating and collaborating. These activities are not compulsory; instead they are motivated by an interest to know, share, create, connect and interact. As a result, the use of social web tools for learning has become quite common since systems like wikis, forums, blogs and other social networking sites became open, easily available and user friendly. The social web has become an interaction platform that fosters and promotes the development of learning communities or networks, in which learning can happen unexpectedly as a result of the connections and interactions of their members (Siemens, 2005a; Downes, 2006; Naeve et al., 2008; Wenger, 2008). Thus, learning becomes a product of social interaction through distributed, yet context situated and highly connected knowledge exchange sustained by a collective practice. The exchanges or interactions harnessed by the use of such tools are emphasised by modern learning theories as being highly significant for the quality of learning and as providing a reliable database which can be processed to analyse, among other processes, knowledge construction.

For several researchers, one of the most powerful research methods to analyse the different aspects of asynchronous online interactions is content analysis of communication transcripts, and many have attempted to develop coding schemes to study, for instance, critical thinking (Newman et al., 1995; Garrison et al., 2001), collaborative learning (Murphy, 2004), cognitive, social and teaching presence (Henri, 1992; Anderson et al., 2001) and, most important for the present work, knowledge construction (Zhu, 1996; Gunawardena et al., 1997; Fahy et al., 2000; Veerman and Veldhuis-Diermanse, 2001; Pena-Shaff and Nicholls, 2004; Weinberger and Fischer, 2006). However, and despite the existence of different coding schemes and the several studies that have explored the process of knowledge construction through asynchronous discussions (Zhu, 1996; Gunawardena et al., 1997; Marra et al., 2004; Paulus, 2007; De Wever et al., 2008; Sing and Chee, 2009, to name but a few), evidence that it occurs at high levels of thought is usually poor and flaws in such studies are often pointed out. Moreover, studies on deploying social web tools for knowledge construction are scarce and questions on whether knowledge construction in open and flexible contexts can be analysed using the methods used so far should be considered.

This work attempts to analyse the process of knowledge construction supported by open social web tools in an open, distributed and learner-managed learning environment. It is by no means comprehensive due to its limited duration and scope, but it provides data on how the use of these tools impacted knowledge construction and on how future studies could be designed.

## 2 Social web and knowledge construction

The social web, Web 2.0 or second generation of the World Wide Web has become a network based on a philosophy of collaboration, social interaction and participation (O'Reilly, 2005; Chatti et al., 2007; Lichtenstein and Parker, 2009). The philosophy underlying the web carries us to a boundless space, where we can connect with whatever or whoever we want to see, hear or know, but this would not be possible without the technology that could support it. Social networking tools, such as wikis, blogs, social

networking sites, social bookmarking sites, among many others, have, at least, two specific features in common: the personal control they allow to users and the interaction they afford. They enable the exploration of different learning paths, learning through exploration, wandering and finding the way. They allow people to make connections, to make individual choices and define their own knowledge areas. In sum, they empower them to manage knowledge and construct it by engaging in a process of 'coming to know' based on shared understanding, negotiation and readjustments.

Knowledge construction is generally described as being both a personal process of accommodating knowledge into the existing cognitive schema, and a social process of sharing, negotiating and creating new meanings (Scardamalia and Bereiter, 1994; Jonassen et al., 1995; Stahl, 2000). Thus, one builds knowledge by (re)organising pre-existing personal cognitive schema, by reflecting and by interacting with others. It is not only a personal process of interaction with oneself, but also an interaction process with our surroundings, including people, artefacts and environments.

Such principles are rooted in social-cultural theories that view learning as a process of social interaction. For social-constructivism, interaction is the key mediator for the construction of shared perspectives and shared knowledge. Focus is placed on the learner and approaches draw on learning by doing, problem solving, mediating learning tools and facilitators who encourage the development of the learners' ability to think, reflect and assume responsibility for their own learning (Vygotsky, 1978; Von Glasersfeld, 1995).

Although such views clearly draw on socio-constructivist theories, we believe they also place relative emphasis on the notions of distributed cognition and connectivism which, building on socio-constructivist principles, highlight how objects, tools and environments can influence the process of knowledge construction.

When we talk about a distributed learning environment supported by different social web tools, we find that such notions may help us understand the effect technology has on how we learn and illustrate the type of connections that happen in online interactions. In this sense, connectivism, which Siemens describes as a new theory for learning based on network structures, complex changing environments and distributed cognition (Siemens, 2005b), emphasises the importance of learners' active participation in learning. For connectivism, individuals chose their learning paths and control their connections, and learning happens when they connect, when they are able to build, organise, expand and recognise patterns that allow them to interpret and understand the knowledge and cognitions found along the way or left by others.

The notion of distributed cognition within connectivism is specifically relevant for our work for it opposes the notion of cognitions being "possessed and residing in the heads of individuals" [Salomon, (1993), p.xi]. Thus, tools, artefacts and social interactions residing outside people's heads are not mere "sources of stimulation and guidance, but are actually vehicles of thought, for (…) it is not just the 'person-solo' who learns, but the 'person-plus', the whole system of interrelated factors" [Perkins, (1993), p.89].

Under such assumptions, context becomes highly relevant, for it brings as much to a space of knowledge connection and exchange as do the parties involved in the exchange. The context of our study played a significant role in what interactions are concerned, for it placed students at the centre of the learning activity, enabling them to control and monitor their own learning, manage activities, course goals, develop specific skills and establish desired connections. Also, when designing the course, emphasis was placed on

community building and knowledge sharing which resulted in the implementation of pedagogical activities that included the participation in synchronous and asynchronous discussions for shared knowledge construction and project-based learning for real world application.

## 3 Research context

The present study was conducted in the context of a first year course subject – multimedia and cognitive architectures (MCA) – which was part of the masters degree on multimedia in education (MMEdu) offered to students under a b-learning regime at the University of Aveiro. The course combined two face-to-face (f2f) sessions and distance work for the span of four weeks. The course started in February and ended in March. Tasks and schedules were planned as follows (see Table 1):

**Table 1** MCA chronogram

| *04 to 07/02* | *08 to 09/02* | *10 to 28/02* | *29/02 to 01/03* |
|---|---|---|---|
| *Online* | *f2f* | *Online* | *f2f* |
| • Framing discussion of the issues to be addressed in the course in the blog 'mundomac'.<br>• Reading and analysis of some guidance documents and resources to be explored in the course. | • Presentation of the course and assessment criteria.<br>• Teaching and learning strategies.<br>• Cognition and learning.<br>• Distributed cognition.<br>• Multimedia, Web 2.0 and interaction.<br>• Discussion and choice of work group.<br>• Monitoring of the initial reflection. | • Development at a distance (accompanied) of the PDI. Documentation of activities in the group blogs, the wiki or in other tools that reflect the dynamics of this collaborative process.<br>• Collaborative development of the blog, the best of PDI – a blog created for the community. | • Presentaion and discussion ofthe projects developed.<br>• Self and peer assessment. |

The tools adopted to distribute the MCA learning environment and their specific purposes can be found in previous work (Lucas and Moreira, 2009a). For the purpose of the present work, we will only refer to the use of the two blogs created for the course ('mundomac' and 'bestofpdi', as referred in Table 1).

In this course, students, mainly in-service teachers, were expected to deepen their knowledge about cognitive systems and to reflect upon learning theories related to the process of knowledge building. As the course was highly practical and demanded 'hands-on' involvement, students were asked to explore the potential of social networking tools to augment interaction by conceiving a plan for the development of interaction (PDI). After feedback given on the project developed, they were challenged to implement it as an in-class activity, which they did with very interesting impacts.

Preliminary results reported in previous work (Lucas and Moreira, 2009b) suggest that along with the aforementioned objectives, students felt to have developed skills and competences related to their professional activities, such as:

1 integrating CT into teaching practices

2 promoting and exploring interaction practices when planning pedagogical activities – curricular and non-curricular

3 harnessing informal learning outcomes that derive from the use of CT or the participation in such activities

4 developing collaborative work, research, management and information organisation skills.

In MCA, a total of 56 students were divided into ten groups (of 5–6 members each). They were not required a minimum or maximum number of contributions in the discussions launched in the two blogs used in the course, but participation represented 15% of the course assessment. As a group, students had to develop their PDI and implement it as a pedagogical activity. They were free to explore and adopt whichever tool they felt was more appropriate for the planned PDI. They also had to administer and dynamise the blog 'bestofpdi' for the span of one day.

Topics discussed in the blog 'mundomac' were launched by the course teachers and followed no previous schedule, i.e., after the initial post, which framed some of the issues being explored during the course, topics for further discussions emerged from the interaction that was taking place. The topics explored in the blog 'bestofpdi' were launched by students, who were free to choose what they wanted to share and discuss as long as it related to the issues being dealt with in the course, in their PDI or in their professional activity. Topics dealt in this blog were unveiled by each group at the beginning of their moderation day; they ranged from etwinning to violence in schools or game based learning and discussion usually included the role played or that can be played by CT in such areas. The management schedule of the blog was negotiated among teachers and students in 'mundomac' and it comprised ten days (one day per group).

## 4 Research question

The main research question that guided the present work focused on whether the use of open social web tools as a means to distribute a learning environment had had an impact on the process of knowledge construction, i.e., to what extent were students constructing knowledge? A secondary question of this work is related to the viability of the analysis model used in the context of our study.

## 5 Data analysis

The discussion transcripts of 28 posts were selected for this study, which resulted in 758 messages, from which 712 were analysed.

In order to analyse the level of knowledge construction through social negotiation, we used the interaction analysis model developed by Gunawardena et al. (1997). This model

is based on the principles of socio-constructivism and examines the social construction of knowledge in five different levels of activity:

1 sharing and comparing information

2 identifying areas of disagreement

3 negotiating meaning and co-construction of knowledge

4 evaluation and modification of new schemas that result from co-construction

5 reaching and stating agreement and application of co-constructed knowledge.

Although we explored and considered the application of other models (Zhu, 1996; Veerman and Veldhuis-Diermanse, 2001; Pena-Shaff and Nicholls, 2004), we opted for the one proposed by Gunawardena et al., based on the following criteria:

1 it is one of the most cited models in scholarly databases

2 it has been applied in a considerable number of recent empirical studies (Marra et al., 2004; Schellens and Valcke, 2005; Paulus, 2007; De Wever et al., 2008, 2009; Sing and Chee, 2009; Wang et al., 2009; Hou et al., 2009)

3 we feel some degree of confidence as far as its replicability and validity, bearing in mind the number of times the instrument has been applied and used as a basis for the development of other instruments (Veerman and Veldhuis-Diermanse, 2001. cf. Schellens and Valcke, 2005).

Furthermore, the model is recognised to place a strong focus on interaction as the vehicle for shared construction of knowledge and as being appropriate in social constructivist and collaborative learning contexts.

When we started the coding process, we determined the whole message as our unit of analysis, inline with Rourke et al. (2001), who established it as objectively identifiable and whose parameters are determined by the author of the message. However, due to the length and depth of the posts, we felt it inappropriate to code some of the messages in only one of the phases, since we were able to identify more than one phase in some of them. As a result we adopted the coding steps suggested by different authors (Chi, 1997; Marra et al., 2004), applying the highest phase evidenced in each message as a coding result.

Teachers' messages were coded and treated as any other message, as their role in the course was that of co-learners, sometimes monitoring the discussion but almost never modelling the actions that could stimulate knowledge construction. Instead, they shared, asked and collaborated in a way that their presence became diluted in the course of events.

Three independent coders codified the messages. Two were familiar with the model and had already used it in the course of their work, whereas the other had never used it. An initial meeting took place for this coder to work with examples of the different levels of knowledge construction and to discuss details regarding the model and its application. The transcripts were then coded by each of the coders. In order to verify reliability of results, a sample was randomly selected and recoded. After discussion and consensus negotiation, the three coders reached a final codification.

## 6 Results and discussion

The total number of messages presented in the following table (see Table 2) refers to messages from both blogs. Although we find the highest number of occurrences in phase I, suggesting that there was a high focus on sharing and comparing knowledge, we also find the number of occurrences in the other phases as very balanced, which may indicate that students were building on each other's ideas. In fact, bearing in mind that phases II to V correspond to phases indicating knowledge construction, we may conclude the percentage of messages within the knowledge construction process results in 59% of the total number of messages coded.

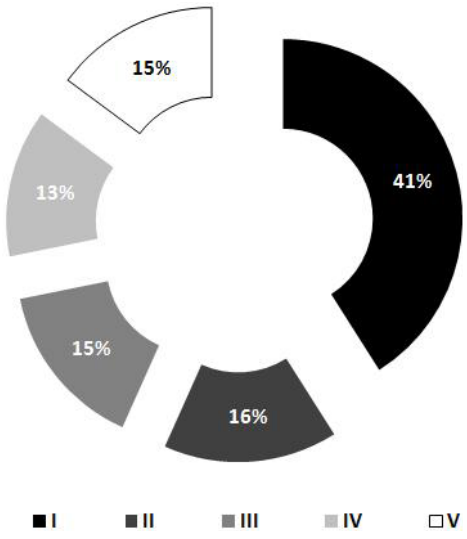
**Table 2** Occurrences based on coding categories

| *Phases* | | *Total* |
|---|---|---|
| I | Sharing and comparing information | 290 |
| II | Indentifying areas of disagreement | 111 |
| III | Negotiation meaning and co-construction of knowledge | 107 |
| IV | Evaluation and modification of new schemas that result from co-construction | 99 |
| V | Stating agreement and application of co-constructed knowledge | 105 |
| Toatal | | 712 |

*Source:* Gunawardena et al. (1997)

The proportion of coded phases is presented and highlighted in the following pie chart (Figure 1).

**Figure 1** Distribution of knowledge construction activities among the five phases




The most common activity was exchanging ideas, opinions and experiences (41%). As most students were teachers and shared a common professional background, it seems natural that they shared and exchanged their experiences, known resources or information, which they found useful for their activity. By resorting to these activities,

students supported and provided feedback on each other's ideas and experiences, but did not necessarily act upon them to construct knowledge, since exchanging information, sharing resources or agreeing with what had already been said does not cause disagreement or cognitive conflict. Therefore, such interactions remain in phase I.

When students experienced conflict and inconsistency in ideas, they had to negotiate meaning, making it possible for higher levels of knowledge construction to happen. 16% of the activity coded in phase II involved some form of meaning negotiation. Students counter-argumented and sometimes criticised or provoked reactions. Some restated arguments by using different sources of information or posed pertinent questions. By doing so, they raised the opportunity for further discussions and exchange of ideas, which challenged many of the initial opinions.

The percentage obtained in phase III seems, to a certain extent, to illustrate the advancement of arguments obtained in phase II. 15% of the messages reveal that students pursued the discussion by proposing alternative views and compromising with them. This result may lead us to think that these activities opened the opportunity for students to discuss different points of view and reach a common understanding, as results obtained in the highest phases of knowledge construction are similar to this, suggesting a balanced pattern of knowledge construction involving participant students as a whole. 15% was the percentage obtained in phase V, which refers to messages that evidence accommodation of new knowledge (or its synthesis) on the part of the students. A lower percentage, although almost in line with the one obtained in phases II, III and V, was gathered in phase IV. The evaluation and modification of new schemas that result from co-construction correspond to 13% of the total of coded messages. This happened mostly due to the confrontation of new meanings proposed and students' personal experiences.

Although results show that the highest percentage of interactions occurred in phase I, which is in line with most studies (Gunawardena et al., 1997; Paulus, 2007; Schellens and Valcke, 2005; Sing and Chee, 2009; Wang et al., 2009; Hou et al., 2009), results differ from these in the highest levels of knowledge construction. We find similar percentages in phases II to V, which may suggest increments in knowledge construction. Besides, triangulation with other data (Lucas and Moreira, 2009a, 2009b) suggests that students perceived the 'hands-on' experience developed in MCA as a valuable one, that allowed them to develop their skills, develop new ways of learning and build new knowledge, not only socially as a community by means of sharing and collaborating, but also internally by means of personal meaning negotiation and adjustment of new ideas. Furthermore, they emphasised the role played by social web tools in the openness of the learning environment and in their motivation to learn, share, create, connect, interact and learn.

Such results made us question the use and viability of the coding scheme in our educational context. Although its application has been widely used in different studies, we find it lacks the capability to demonstrate the social and interaction dynamics that go beyond the categorisation proposed for the knowledge construction stages. Furthermore, it does not provide an accurate picture of the progress and development of students' knowledge.

## 7 Conclusions

In the past few years, the evolution of internet applications, now called social web, has placed strong emphasis on sharing, participating and collaborating. Such evolution has

posed new opportunities for learning and set renewed challenges for the analysis of knowledge construction.

In this paper we sought to analyse the process of knowledge construction in an open and distributed learning environment supported by the use of social web tools and results seem to suggest that students built on each other's ideas and constructed knowledge. Nevertheless, we felt some inadequacies regarding the application and viability of the coding scheme used for the analysis of knowledge construction. Although it presents clear and validated stages for knowledge construction, we sense it does not truly reflect the meaning of students' knowledge construction, for it does not capture interactions that go beyond the explicit ones, such as 'unspoken' interactions between participants and their environment, nor the chronological and systemic evolution of such interactions.

Further insights concerning the present study, including the validity of the model used in the analysis of the transcripts and visualisation of the interaction dynamics itself will be the object of future work.

## Acknowledgements

The authors wish to thank the Portuguese Foundation for Science and Technology – FCT – for supporting the study under Contract No. SFRH/BD/41797/2007.

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