“Scaffolding of Self-Regulated Learning in Social Networks”

By

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M.Sc. Dissertation

RECIFE, MAY/2010
“Scaffolding of Self-Regulated Learning in Social Networks”

Trabalho apresentado ao Programa de Pós-graduação em Ciência da Computação do Centro de Informática da Universidade Federal de Pernambuco como requisito parcial para obtenção do grau de Mestre em Ciência da Computação.

A M.Sc. Dissertation presented to the Federal University of Pernambuco in partial fulfillment of the requirements for the degree of M.Sc. in Computer Science.

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RECIFE, MAY/2010
Melo, Cássio de Albuquerque
  xiii, 94 folhas : il., fig., tab.


Inclui bibliografia e apêndice.


371.35 CDD (22. ed.) MEI2010 - 0147
All the expenses related to my master course were paid by millions of Brazilians who I never met and worked hard to pay the taxes. I wish to dedicate this dissertation to them.
Acknowledgements

First, I want to express my gratitude to my advisor, friend and guru, Alex Sandro, for his support to this dissertation who I express my sincere admiration.

I want to thank my parents, Raimundo and Ana; my sisters Monize, Isis and Patricia; and my girlfriend Sumaia, for their affection, support and care.

To my friends of Redu, Guilherme Paiva, Guilherme Cavalcanti, André and Anderson. They have been very enthusiastic of this work and made it possible. Also thanks to Daniel Arcoverde who I had great discussions through my masters course.

I have spent part of my masters course at INRIA, where I had an amazing experience as a research intern. I would like to thank to Francisco Carvalho, Marie-Aude Aufaure and Yves Lechevallier. They trusted my potential as a researcher, always entertaining my questions with interest and patience.

Thanks to everyone who I interacted with and participated in projects, as well as all CCTE members who reviewed this work over and over giving me worthy suggestions. I’ve met a lot of innovative guys and they all deserve big kudos.

Thanks to CNPq research fund that granted this work and ÉGIDE for the INRIA scholarship.

As always, there are many others who made great contributions to this work but the folks mentioned are those who I worked with day-to-day. Thanks, everyone.
Better try and fail
To worry as life passes by
Better still try in vain
To sit down and wait until the end
I prefer walking in the rain
To hide in sad days
I'd rather be happy, mad though,
To a conformity life.

—MARTIN LUTHER KING JR.
Scaffoldings são apoios a aprendizes novatos através de uma simplificação do contexto de aprendizagem. Estes apoios são gradualmente removidos à medida que os alunos desenvolvem estratégias autônomas de aprendizagem (processo conhecido como “fading”). Em ambientes de aprendizagem online, os scaffoldings podem ser implementados através de um conjunto de funcionalidades que promovam o planejamento de objetivos, auto-monitoramento, auto-avaliação, estratégias de aprendizado, procura de ajuda, e planejamento e gerenciamento do tempo. Enquanto scaffoldings do Aprendizado Auto-Regulado (AAR) têm sido discutidos em ambientes tradicionais de aprendizagem, as redes sociais online têm pouca ou nenhuma atenção neste domínio. O presente estudo é focado em scaffoldings do AAR em redes sociais, pois acreditamos que as redes sociais têm estilos de interação que influenciam mais notadamente as habilidades individuais e coletivas do AAR.

Nós coletamos itens do AAR no estado-da-arte sobre metacognição e aprendizagem, definimos suas metas e sugerimos scaffoldings para o AAR em redes sociais. Cada item foi extraído a partir de vários estudos na literatura sobre Computer-Supported Collaborative Learning (CSCL) e o AAR; dados quantitativos e qualitativos a partir de relatórios; estudos de caso; questionários AAR e outros recursos mencionados ao longo deste trabalho.

Nós implementamos os mecanismos de scaffoldings na rede social Rede Social Educacional (Redu). Redu oferece um espaço de trabalho compartilhado, onde os alunos são incentivados a publicar os seus documentos e notas de aula, enquanto o professor fornece documentos e faz comentários para a classe. Os mecanismos de scaffoldings sugeridos incluem: 1) Blogs, comentários e fórum; 2) Instruções sobre tarefas, 3) Ajuda contextual e políticas de uso; 4) Perguntas para reflexão; 5) Fluxo de atividades; 6) Criação e compartilhamento de recursos; 7) Perfil de aprendizagem, 8) Notas de aula; 9) Discussões e assistência par-a-par; 10) Exames formativos; 11) Feedback de desempenho e orientação; 12) Mecanismos de recompensa e; 13) Visualização de informação.

Em resumo, este trabalho sugere que uma rede social de aprendizagem pode ser concebida para melhorar o aprendizado auto-regulado através de mecanismos de scaffoldings apropriados.

Palavras-chave: aprendizado auto-regulado, metacognição, auto-avaliação, redes sociais, CSCL
Abstract

Scaffolding is the provision of support to novice learners by a simplification of the learning context. These supports are gradually removed as students develop autonomous learning strategies (a process known as “fading”). In online learning environments, scaffolding can be implemented through a set of features that promotes goal setting, self-monitoring, self-evaluating, task strategies, help seeking, and time planning and management. While Self-Regulated Learning (SRL) scaffolding has been recently discussed in traditional learning environments, online social networks pay little or no attention to this field. The present study focused on scaffolding SRL in social networks because we believe social networks have remarkable styles of interaction that would increase influence to both individual and collective SRL skills.

We have collected SRL items from the current state-of-art on metacognition and self-regulated learning, defined its goals and suggested SRL scaffoldings for social networks. Each item was excepted or indirectly inferred from several studies in the literature on Computer-Supported Collaborative Learning (CSCL) and self-regulation; Quantitative and qualitative data from reports; Case studies; SRL inventories; and other resources mentioned throughout this work.

We have defined and implemented SRL scaffolds in the Redu learning network. Redu offers a shared workspace where students are encouraged to publish their documents and notes, while the teacher uses it to deliver documents and comments to the class. The suggested scaffolds include: 1) Blogging, Commenting and Forum; 2) Task Instructions, 3) Contextual Aids and Use Policies; 4) Prompts for Reflection; 5) Activity Streams; 6) Resources Creation and Sharing; 7) Learning Profile; 8) Lecture Notes; 9) Peer Discussion and Assistance; 10) Quizzes and Rubrics; 11) Performance Feedback and Guidance; 12) Rewarding Participation and; 13) Information Visualization.

In sum, this work suggests that a learning social network can be designed to enhance people’s self-regulated learning capacities and to help they understand the importance of their beliefs in themselves as self-regulators.

**Keywords:** self-regulated learning, metacognition, self-assessment, social networks, CSCL
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Effective regulation of metacognitive skills is a decisive factor in the successful completion of any cognitive task (Flavell, 1979). The notion of metacognition has to do with peoples’ ability to be aware of and on control of their own thinking. For instance, how they select their learning goals, use prior knowledge or intentionally choose problem-solving strategies (Barak, 2009). When a student is preparing to take an exam, he or she will analyze its difficulty and based on this judgment, allocate study time and define the kind of strategy used to reach his or her learning goal, which would presumably be, pass the exam. During the study, he or she checks continually whether he or she has studied long enough, whether the learning strategy employed is working well or what could be done to study more effectively or to overcome a difficulty. This process is known as self-monitoring, and it is related to one’s own ability to evaluate the outcomes of his or her efforts. When people lack these strategies, they reach erroneous conclusions and make unfortunate choices. They lack the ability to realize it (Kruger and Dunning, 1999). Many studies identified significant positive correlations between academic achievement and Self-Regulated Learning (SRL) ability among students (Dabbagh and Kitsantas, 2005; Narciss et al., 2007; Schunk, 1994).

Many activities related to learning take place outside the formal settings of the school and those experiences are often unacknowledged by educators. In particular, when it comes to the online learning the need for higher self-regulated behavior is even more
evident. Without the physical presence of a teacher, students need to cope with a high degree of self-regulatory competence to accomplish their learning goals (Chen, 2009). Neglecting the fact that autonomous online learning demands higher self-regulated skills from students, some existing tools fail to engage students in the learning process that would allow them to know their deficits and take actions to improve their cognitive abilities.

In a report about best practices in online learning, the U.S. Department of Education (Means et al., 2009) evidenced the requirements for learning environments which engage students in appropriate self-regulative activities. Features such as prompts for reflection, self-explanation and self-monitoring strategies have promised to improve online learning outcomes. Another recent report on the “6 Technologies That Will Shape Education” (Johnson et al., 2010) classified the technologies that will have an impact in the near future, those that are in the early stages of adoption, and those that are going to be adopted in the next few years. This year, the report identified “critical” challenges to be considered by the technologies for education in the near future. They include:

- Inadequate digital media literacy training for teachers;
- Out of date learning materials and teaching practices;
- Lack of agreement on how education should evolve, despite widespread agreement that change is needed;
- A failure of education institutions to adapt to informal education, online education, and home-based learning; and
- Lack of support for or acknowledgment of forms of learning that usually occur outside the classroom.

On this last point, the report says:

> Beyond the classroom walls, students can take advantage of online resources, explore ideas and practice skills using games and other programs they may have on systems at home, and interact with their extensive—and constantly available—social networks. Within the classroom, learning that incorporates real life experiences like these is not occurring enough and is too often undervalued when it does take place. This challenge is an important one in K-12 schools, because it results in a lack of engagement in learning on the
1.1. MOTIVATION

part of students who are seeking some connection between their world, their own lives, and their experience in school. (p. 5)

Outside the formal settings of a classroom, students interact informally with the environment, creating learning opportunities and rich experiences that will accompany them throughout their lives. These experiences are often undervalued or unacknowledged.

1.1 Motivation

In a recent survey conducted by the US National Schools Board Association, 96% of students aged 9-17 years participate in social networking services (NSBA, 2007). Students spend on average 9 hours per week posting messages; sharing audio, video and pictures; site building; blogging; and creating content. Moreover, 59% of all social networking listened users discuss education-related topics such as future study; learning outside school; careers or jobs; politics, ideas, religion or morals; and school work. For 60 percent of this public, some of the most popular social networking topics were: college planning, learning outside of school, careers, and schoolwork. They also report posting writing and art projects that may have nothing to do with schoolwork.

The proliferation of social networking highlights the potential of this kind of social environment for Education. In particular, there is some accordance with social constructivist theory (Greenhow, 2009). The social constructivist theory emphasizes that people produce knowledge together, inside a culture of shared meaning (Wenger, 1998). Following this hypothesis, collaborative environments try to encourage students to construct knowledge collectively offering then opportunities to participate in activities like: messaging, blogging and shared references. Social software can assist learners to: (a) access information, (b) improve ideas, (c) communicate to each other, (d) make decisions regarding their learning goals or how much support is needed from contextual resources, (e) intentionally choosing problem-solving strategies, and (f) effectively receiving and using feedback from their tutors, peers or technological means (Barak., 2009). Learning phenomena or social participation in social networks involve metacognitive processes like mutual regulation and reflection when understanding one’s own tasks or learning strategy.

Current social software environment have yet to deliver their potential. According to a number of studies (Conole, 2008; Means et al., 2009; Wang and Li, 2006) more efforts are required to uncover social networks in learning and explore the social dimension of self-regulation in these environments. More specifically, the state of the art guide us to
questions like: how can social networks help students become self-regulated learners? Other, what processes of SRL should be supported? More generally, what does the social mediated SRL mean?

1.2 Overview of the Proposed Solution

Scaffolding corresponds to the kind of support that novice learners need to simplify learning in context (Azevedo and Hadwin, 2005b). These supports are gradually removed as students develop autonomous learning strategies (a process known as “fading”) (Young, 1993). In online learning environments, scaffolding can be implemented through a set of features that promotes goal setting, self-monitoring, self-evaluating, task strategies, help seeking, and time planning and management. While SRL scaffolding was recently discussed in traditional learning environments (Kitsantas and Dabbargh, 2004; Dabbagh and Kitsantas, 2005; Azevedo and Hadwin, 2005a). Online social networks still have little attention in this field.

The present study focused in scaffolding SRL in social networks. We believe social networks environments promote remarkable social interaction styles, which would influence both individual and collective SRL skills. We have collected self-items from the current state-of-art on metacognition and self-regulated learning, defined its goals and suggested SRL scaffoldings for them. Each item was excepted or indirectly inferred from several studies in the literature on CSCL and self-regulation, to name a few: (de Carvalho Filho, 2001; Nicol and Macfarlane-Dick, 2006; Pintrich, 1999; Cho et al., 2007; Kitsantas and Dabbargh, 2004; Dabbagh and Kitsantas, 2005; Azevedo and Hadwin, 2005a); Quantitative and qualitative data from reports (Means et al., 2009; Johnson et al., 2010); Case studies (Narss et al., 2007; Jones et al., 2008; Bannert and Mengelkamp, 2008); SRL inventories (Weinstein C.E. and A.C., 1987; Pintrich and DeGroot, 1990) among other resources mentioned throughout this work.

We have defined and implemented SRL scaffold interaction styles in the Redu learning social network. Redu offers a shared workspace where students were encouraged to publish their documents and notes, while the teacher used it to deliver documents and comments to the class. The suggested scaffolds include: 1) Blogging, Commenting and Forum; 2) Task Instructions, 3) Contextual Aids and Use Policies; 4) Prompts for Reflection; 5) Activity Streams; 6) Resources Creation and Sharing; 7) Learning Profile; 8) Lecture Notes; 9) Peer Discussion and Assistance; 10) Quizzes and Rubrics; 11) Performance Feedback and Guidance; 12) Rewarding Participation and 13) Information
Visualization.

In sum, this work proposes new interaction styles to Redu from the literature about learning in social network context. Our intention is to enhance people’s self-regulated learning strategies through the socio software interface and to help they understand the importance of their self-beliefs as self-regulators. The impact on learning was validated with a control group of students during two weeks.

1.3 Objectives

In this work we sought to study aspects of metacognition related to learning in online social networks. The main objective of this study may be stated as:

*To study some of the online social network practices that contributes to the development of self-regulatory skills in the new collaborative situations available in Redu.*

In order to accomplish the above mentioned objective we thus divide this work to two task-level objectives:

- Evaluate if there is a significant self-regulatory behavior increasing resulted by the use of the self-regulated facilitators in Redu and;

- Describe learner’s awareness about strategies, people and resources available that may be used to accomplish his or her collaborative learning goals in Redu.

Dabbagh and Kitsantas (Dabbagh and Kitsantas, 2005) address three interesting questions regarding SRL in online environments: (1) what does research tell us about guiding and scaffolding metacognition and SRL? (2) How might this research guide the development of metacognitive tools to foster and sustain students’ metacognitive processes and SRL? and (3) What are the challenges we must face in designing adaptive scaffolds that can guide learners to develop and revise self-regulatory skills and processes? Similarly, we want to qualitatively evaluate the link between metacognition and learning performance in order to find out what kind of scaffolding can improve the students’ SRL skills when using Redu. In this sense, we hypothesize that this social network can offer an interesting ground for comparison among learners, as they are better able to understand their interactions within the network, and potentially develop self-regulatory skills as a result (Bandura, 1989). For instance, students can regulate their learning by communicating learning strategies with other through a discussion forum.
We evaluate the effectiveness of proposed items by Pre- post-tests experiments with a group of university students (n=16) counterbalanced by SRL skills during one month.

1.4 Organization

This study is organized in five chapters. Chapter 2 overviews the state-of-art on metacognition and self-regulated learning, providing guidelines for SRL scaffolds in social networks and for the Redu design; Chapter 3 describes the SRL scaffolds that contributes to the goal setting, self-monitoring, self-evaluating, task strategies, help seeking, and time planning and management in social networks. Chapter 4 presents a method for evaluation the impact of the Redu design on this phenomena and the outcomes of this study are then discussed and compared. Conclusion and future work are summarized in Chapter 5.
Creating knowledge is what will be most exciting in life. To create knowledge you have to have passion, so find a challenge that you can be passionate about and you can find the ideas to overcome that challenge.

—RAY KURZWEIL

Learning is a complex phenomenon that has been approached by several theorists during the last century, most notably the behaviorist (Watson, 1925; Pavlov, 1928; Skinner, 1974); cognitivist (Merrill et al., 1991); and humanist (Maslow et al., 1998; Rogers, 1969; DeCarvalho, 1991). The focus of social learning theories to whom interactions between people are the primary mechanism of learning, emerged in early XIX’s, mostly credited to Lev Vygotsky and his theory of social development (Wertsch, 1985).

Social learning theory has its roots in the constructivist theory. According to the constructivism, every time an individual perceives an object, either physically or mentally, he or she tries to assimilate it using his existing schemes from past experiences. Assimilation is the apprehension of a new situation or object while accommodation is the modification process of the internal state of mind. Learning, according to the constructivists, lies on this dual, changing and continuous process of assimilation and accommodation. The seminal work of Piaget is also relevant to research on metacognition since it deals with the development of cognition in children (Flavell, 1979).

Influenced by Piaget’s ideas, Lev Vygotsky highlighted several gaps in the constructivist theory, notably regarding the importance of social aspects in learning (Wertsch, 1985). Vygotsky’s social development theory claims that social interaction plays a fundamental role in the development of cognition. In the social constructivist tradition,
knowledge is socially constructed by interactions among individuals and the environment. Social learning theories have proliferated during the past several years, particularly, there’s a growing number of research that investigates how learning occurs outside the classroom. In the perspective of the communities of practice, for example, learning is situated in a specific context and involved within a particular social environment (Lave and Wenger, 1991). Communities of practice refer to groups who shares commons interests and desires to learn from and contribute to the community with their variety of experiences, usually unintentional rather than deliberate. They develop a unique perspective on their topic as well as a body of common knowledge, practices and engage in work-relevant knowledge building (Wenger, 1998).

Recently, with the expansion of online communities, community-based learning has expanded unprecedented due to the accessibility, plenty of resources and space-time free interaction with each other member. In those communities, learners can deal with distinct resources according to their individual needs and preferences by allowing not only the access to the information but also and most importantly, to create and share content and consequently taking a proactive role in the knowledge building process (Kimmerle et al., 2009a,b). The universal access to multiples sources of information has also bought new challenges to the learner. It creates additional cognitive demands, such as higher discerning skills to select the right strategy in the learn process. The non-linearity of web-based learning can easily distract the student leading to loss of focus on the task. Furthermore, the quality, consistency and reliability of online documents are often arguably (Narciss et al., 2007). All this sets exposes learners in situations in which they, in addition to setting their learning objectives, plan, conduct, regulate and evaluate the learning process independently (Boekaerts, 1999; Zimmerman, 2000).

Research in this area has been done in 1) Designing learning environments (Roll et al., 2007; Narciss et al., 2007; Dennen, 2008); 2) Fostering learner’s self-regulation skills (de Carvalho Filho and Yuzawa, 2001; Kitsantas and Dabbargh, 2004; Azevedo and Hadwin, 2005a; Dabbagh and Kitsantas, 2005; Jones et al., 2008) and 3) Modeling the self-regulated learning (Boekaerts, 1999; Zimmerman, 2000; Barak., 2009).

In the following sections we review the concepts of metacognition and self-regulated learning and how the research in those fields has implications in the current work. We conclude this chapter by suggesting a set of guidelines that a learning social network may
have in order to scaffold the self-regulated learning of students.

2.1 Metacognitive Aspects of Learning

There is not a clear, precise definition of metacognition in the literature (see (Kayashima et al., 2004) for a discussion). John Flavell, regarded as a prime researcher in metacognition, has defined it as follows:

*In any kind of cognitive transaction with the human or non-human environment, a variety of information processing activities may go on. Metacognition refers, among other things, to the active monitoring and consequent regulation and orchestration of these processes in relation to the cognitive objects or data on which they bear, usually in service of some concrete goal or objective.* (Flavell, 1979) (p.232)

According to him, metacognition consists of both metacognitive knowledge and metacognitive experiences of regulation. It consists of two basic processes occurring simultaneously: monitoring one’s progress as he or she learns, and making changes and adapting one’s strategies if he or she perceives that is not doing so well. Flavell acknowledges that the metacognition process might not differ from conscious and unconscious actions or that a conscious action may be triggered by an unconscious thinking.

A recent definition by Ormrod describes metacognition as

*one’s knowledge and beliefs about one’s own cognitive processes and one’s resulting attempts to regulate those cognitive processes to maximize learning and memory.* (Ormrod, 2008)

Here Ormrod stresses the importance of the one’s self-beliefs and monitoring the outcomes of the learning process. In a common sense, the notion of metacognition deals with peoples’ ability to be aware of and control their own thinking. For instance, activities such as planning how to approach a given learning task, monitoring comprehension, and evaluating progress towards the completion of a task are metacognitive in nature.

In (Flavell, 1979) Flavell proposed a model of metacognitive monitoring containing four dimensions of metacognition and their relationships: (a) metacognitive knowledge, (b) metacognitive experiences, (c) tasks or goals, and (d) strategies or activities. Metacognitive knowledge refers to acquired knowledge about cognitive processes, knowledge that can be used to control cognitive processes. According to him, this class of knowledge can represent person variables, task variables or strategy variables. Metacognitive experience
2.1. METACOGNITIVE ASPECTS OF LEARNING

is a process in which other information such as memories or past experiences may be recalled as resources in the process of solving a current cognitive problem. The third category, metacognitive goals and tasks, are the desired outcomes or objectives of a cognitive process including for instance, memorization, producing a document or increasing an ability for doing something. Finally, metacognitive strategies are the sequence of processes used to control one’s own cognitive activities and to monitor progress towards a cognitive goal. Those categories are mutually dependent for their successful completion. The model proposed by Flavell is still often referred nowadays and influenced subsequent theories on self-regulated learning such as the one from Zimmerman (Zimmerman, 2000) that we will discuss later in this chapter.

2.1.1 Correlation between Metacognitive Skills and Learning Performance

As discussed before, metacognition plays an important role in communication, reading comprehension, language acquisition, social cognition, attention, self-control, memory, self-instruction, writing, problem solving, and personality development (Flavell, 1979). Many studies have identified a strong positive correlation between academic achievement and self-regulated learning ability among students at different stages of academic development (Dabbagh and Kitsantas, 2005; Narciss et al., 2007; Schunk, 1994). In (Pintrich and DeGroot, 1990) students with higher metacognitive skills outperformed those with lower metacognitive skills in problem-solving tasks. Kirk (de Carvalho Filho and Yuzawa, 2001) claims that knowledge and regulation of cognition plays an important role in predicting performance and the magnitude and accuracy of confidence judgments.

There is also evidence that metacognitive skills differentiate expert learners from novice learners (Kruger and Dunning, 1999; Karabenick, 1996; Dennen, 2008; Nicol and Macfarlane-Dick, 2006). In general novice learners don’t evaluate their comprehension mainly because they are worried primarily in accomplishing their goal. As the novice becomes more expert in the task, he or she shifts the focus to evaluate and make revisions as he or she goes. For example, when reading a page in a textbook and then realizing he or she hasn’t comprehended a single thing. A novice learner would go on to the next page, thinking that merely reading the words on a page is enough. An expert learner would re-read the page until the main concept is understood, or flag a difficult passage to ask for clarification from an instructor or peers later. Students who demonstrate a wide range of metacognitive skills perform better on exams and complete work more efficiently (Karabenick, 1996). They are self-regulated learners who are continuously
2.2. SELF-REGULATED LEARNING

modifying the learning strategies and skills based on their awareness of effectiveness to ensure goal attainment (de Carvalho Filho and Yuzawa, 2001).

2.2 Self-Regulated Learning

Self-regulated learning (Self-Regulated Learning (SRL)) is a kind of metacognitive strategy and refers to the degree to which students are able to become metacognitively, motivationally and behaviorally active participants of their own leaning process (Zimmerman, 1989). McMahon and Luca (McMahon and Luca, 2001) highlights the effects of external environmental factors upon an individual’s ability to regulate their learning. Self-regulation is viewed as the intersection of self-awareness at both a rational and emotional level. According to Dettori (Dettori and Persico, 2008) “SRL is not a mental ability nor an operative skill but rather a student-directed process that transforms mental abilities into operative skills in relation to a specific task and in a given context” (Dettori and Persico, 2008). These self-regulatory activities consists of self-motivation (goal setting and self-efficacy), using learning strategies (task strategies), effort regulation (time management), self-monitoring comprehension, using environments successfully (choosing optimal physical locations), and selective help-seeking (Boekaerts, 1999; Barak., 2009).

The concept of self-regulation is interpreted according to the educational current in question. For example, Zimmerman (Zimmerman, 2000), identifies it in under the perspectives of social cognitive, Vygostkian and constructivism theories. Behaviourist approaches emphasizes self-monitoring, self-instruction and self-reinforcement while a phenomenological approach comprehends dimensions such as self-worth, planning, and goal setting (McMahon and Luca, 2001). For a review in the theories of self-regulation see (McMahon and Luca, 2001) and (de Carvalho Filho, 2001).

Currently, self-regulated learning has received considerable interest in the education and psychology fields. Zimmerman (Zimmerman, 1989) presents an overview of the field with emphasis on social aspects of self-regulated learning. Kirk (de Carvalho Filho, 2001) reviews some of the major theories of self-regulation of learning. In the following section we will describe the widely referred framework by Zimmerman (Zimmerman, 2000), in which we sought to refine the requirements for a web-based system in order to support the self-regulation of learning.
2.2. SELF-REGULATED LEARNING

2.2.1 SRL Models

A wide spectrum of self-regulation models has been proposed since its introduction. Zimmerman (Zimmerman, 2000) describes academic self-regulation as a cyclical process consisting of three phases: (1) forethought, including goal setting, strategic planning, self-efficacy beliefs and intrinsic motivation; (2) performance, volitional control, such as attention focusing, self-instruction and self-monitoring; and (3) self-reflection, such as self-evaluation, attributions and self-reactions (reactions to performance outcomes) (Figure 2.1). This is a cyclic model because information about learning outcomes can alter substantially the subsequent goals, strategies and performance efforts. In other words, learners regulate their own learning by observing what they are able to do, then comparing this what they have observed to a standard or a desired state and making judgments about the quality of this performance, and finally realizing what to do next.

A brief explanation about each step in the Zimmerman model is described below.

**Goal planning**: Refers to a process through which students decide on specific outcomes for learning and identify appropriate strategies to be undertaken to accomplish desired goals (Zimmerman, 2000).

**Self-monitoring**: Is one’s deliberate attention in evaluating the outcomes of his or her
efforts. For example, keeping records that would enable the student to make necessary adjustments in order to align with his or her learning goals. Zimmerman states that self-monitoring is part of a feedback loop in which a student: (a) observes his or her performance; (b) compares his or her performance to a standard of goal; and (C) reacts according to the perceived difference. Self-monitoring therefore leads to self-evaluation.

**Self-evaluation:** Is a SR strategy that occurs when the learner compares outcomes of performance with a standard or goal. Learners monitor their progress towards goal attainment, making evaluation about their performance and about their self-efficacy for reaching the goal. Self-evaluation influences strategic planning for future learning activities (Pintrich, 1999; Nicol and Macfarlane-Dick, 2006).

**Task strategies:** Refers to the selection and use of different learning strategies that the learners consider to accomplish their goals. These strategies may include, for example, drawing mind-maps and mnemonics, re-reading.

**Help-seeking:** Is a SR strategy that occurs when a learner identifies and calls upon outside resources (human or books, material) for assistance in specific learning tasks.

**Time planning and management:** Refers to managing time effectively. Research suggests that students who keep records of time spent on assigned learning tasks begin to recognize patterns in their own use of study time and develop and appreciation for the value of effective time management and its impact on academic achievement (de Carvalho Filho and Yuzawa, 2001).

Boekaerts (Boekaerts, 1999) suggested a similar three-layer model of SRL, including: (1) regulation of the self-choice of goals and resources; (2) regulation of processing methods—use of metacognitive knowledge and skills to direct one’s learning; and (3) regulation of processing modes—choice of cognitive strategies.

Those models provided subsequent applications in on-line education. In a recent article, Barak (Barak., 2009) proposes a model for self-regulated learning in technology education characterized by three dimensions: (1) cognition; (2) metacognition; and (3) motivation. It also discusses the role of technology education in cultivating students’ intellectual competencies. Cognition is related to the conscious process of thinking, the awareness, the reasoning, the knowledge assimilation. Metacognition, as stated before, is any knowledge about selecting, controlling and regulating cognition processes. For instance, time control, strategy planning, self-monitoring and memory. Finally, motivation, that accounts for interest, task value and self-efficacy beliefs. The role of motivation is discussed in a framework by Pintrich (Pintrich, 1999). According to him, self-regulated learning can be facilitated by the adoption of both intrinsic and
extrinsic goals. In the work of Kitsantas (Kitsantas and Dabbagh, 2004) it is suggested a bunch of on-line features that would enable the development of the self-regulation skills aforementioned. Some of them are discussed later in this chapter.

2.3 Social and Environmental Influences on Self-Regulation

Social cognitive theory emphasizes the importance of one’s environments as a determinant factor in self-regulation (Bandura, 1989). The belief that one is capable of attaining a certain goal is acquired in social contexts, through social relations and comparisons (Schunk, 1994). According to Bandura (Bandura, 1989), students acquire information from their peers, family, surrounding community and this information could alter students’ self-regulated learning behavior. In other words, social cognitive theory views self-regulation as a self-generated process that is context-dependent in nature and it is related to one’s self-efficacy beliefs, future outcome expectations, and the use of a range of metacognitive strategies to monitor and control regulatory behavior. For a review on the theories of self-regulated learning see (de Carvalho Filho, 2001).

Kirk (de Carvalho Filho and Yuzawa, 2001) investigated the relationship between knowledge of cognition and regulation of cognition and how they interact to mediate the effects of social cues on confidence judgments. Results revealed that the magnitude of the metamemory judgments assessed was significantly affected by social cues and that participants with a low level of metacognitive ability were more influenced than those with high metacognitive ability. Jones (Jones et al., 2008) studied the relationship between peer discussions about self-regulated learning and students’ self-regulated learning behaviors. Results suggest that the frequency and substance of peer discussions inside and outside the class relates to the self-regulation of learning, especially for students sharing learning strategies with peers and their peer groups.

2.4 Development of Self-Regulatory Skills in Online Learning Environments

Studies demonstrate that metacognition can be promoted through direct instruction in classroom and also in web-based systems (Kitsantas and Dabbagh, 2004; Dabbagh and Kitsantas, 2005; Azevedo and Hadwin, 2005a; Narciss et al., 2007; Chen, 2009). Zimmerman (Zimmerman, 2000) suggests self-regulatory training besides the traditional homework exercises as a mean for becoming better learners. One way to foster student
2.4. DEVELOPMENT OF SELF-REGULATORY SKILLS IN ONLINE LEARNING ENVIRONMENTS

self-regulation is through the use of various kinds of contextual aids. Each one may include access to educational resources or a human tutor who provides individualized scaffolding to foster students’ self-regulated learning (Kitsantas and Dabbargh, 2004). Dettori (Dettori and Persico, 2008) claims that in order to promote active learning in the online environments, it’s necessary to provide suitable feedback to students, and encouraging them to evaluate and revise their outcomes. It’s important therefore, to carefully examining the components of self-regulated learning in order to develop more effective strategies for helping students in the SRL process.

Web-based learning environments often require the learner to assume primary, proactive responsibility on the learning process - the physical absence of the instructor demands that the students cope with a high degree of self-regulatory competence to accomplish their learning goals (Kitsantas and Dabbargh, 2004). On the other hand, students who lack of self-regulatory skills may potentially be at risk of failure in such environments (McMahon and Luca, 2001). In traditional, face-to-face interaction with the instructor, learners are usually monitored more closely. One of the main advantages of online environments is their efficacy in adapting themselves to the needs of individual learners by dynamically providing scaffolding of key learning processes during learning (Azevedo et al., 2006; McMahon and Luca, 2001). This ability is possible through an understanding of how learner characteristics, system features, and the mediating learning processes interact within particular contexts (Azevedo et al., 2006). Additionally, learning in online environments is heavily based on textual interaction, and therefore leads to learner reflection on content and also on the learning process itself (Dettori and Persico, 2008). As a consequence, such learning environments foster the practice of a range of SRL skills by offering different kinds of stimulus, discussed in the following section.

2.4.1 Stimulus to Learner’s Reflection

Many names has been attributed to the online learning, such as computer-supportive learning, computer-assisted learning, and virtual learning but it is most popularly known as Computer-Supported Collaborative Learning (CSCL). Effective use of CSCL environments appears both to require and to improve the ability of learners to self-regulate their own activity (Dettori and Persico, 2008). Empirical research has been done in this area to determine how different adaptive scaffolding methods foster self-regulatory processes that facilitate students’ learning of challenging topics (Azevedo et al., 2006). Kitsantas and Dabbargh (Kitsantas and Dabbargh, 2004) call attention to the effective use of web-based pedagogical tools to support SR. Authors discuss how to support self-regulatory processes
2.4. DEVELOPMENT OF SELF-REGULATORY SKILLS IN ONLINE LEARNING ENVIRONMENTS

in web-based learning environments. Visualizations, assessments, reflective journaling, models and simulations are some options to enhancing self-regulation.

The online learning literature has also explored the effects of using computer-based instruction elements to individualize instruction so that the online learning module or platform responds dynamically to the participant’s questions, needs or performance. For a classification of those systems see (Soller et al., 2005).

McMahon and Luca (McMahon and Luca, 2001) proposed a conceptual framework to help identify students’ self-regulatory skills, as well as a mapping to a validated online testing instrument. The instrument is delivered online, from which a full analysis of the results is immediately returned to both student and tutor in each of these dimensions: items that assess metacognition, items that assess self-concept, items that assess self-monitoring, items that assess motivation, items that assess strategy formation and finally, items that assess volition control strategies. The framework and associated questions related to each of the defined dimensions providing a tool for assessing students’ self-regulatory skills.

Azevedo and Hadwin (Azevedo and Hadwin, 2005a) found that adaptive scaffolding was effective for moving students toward more sophisticated mental models, increasing declarative knowledge, and increasing frequency of some SRL strategies. In a later study, Azevedo et al. (Azevedo et al., 2006) verified the effectiveness of different human scaffolding conditions in facilitating students’ learning dealing with hypermedia. He claims that human tutors can assist students in building their understanding of the topic by providing dynamic scaffolding during learning and assisting them in deploying specific self-regulatory skills (e.g., activating students’ prior knowledge). A human tutor is seen as an external regulatory agent that monitors, evaluates, and provides feedback regarding a student’s self-regulatory skills. Kitsantas and Dabbagh (Dabbagh and Kitsantas, 2005) studied the effectiveness of support provided through Web-based Pedagogical Tools (WBPT) with human instructor supports provided primarily in the form of individualized feedback on a project. Results show that different WBPTs support different self-regulatory strategies.

Dettori and Persico (Dettori and Persico, 2008) investigated the development of SRL in CSCL environments through Interaction Analysis. A set of SRL indicators were proposed according to which kind of skill each one belongs to. For example, comparing one’s work with that of peers is an “evaluation” indicator. Content Analysis and Social Network Analysis were also applied to study SRL in online environments (Dennen, 2008).

Those techniques are discussed further in the Appendix B. In the often referred paper
2.4. DEVELOPMENT OF SELF-REGULATORY SKILLS IN ONLINE LEARNING ENVIRONMENTS

(Soller et al., 2005), its authors classify CSCL environments according to their type of intervention defining three main categories: 1) Mirroring Systems that reflect actions with no evaluation; 2) Monitoring Systems that monitor the state of interaction in comparison with a reference model; and 3) Guiding Systems that offer advice accordingly. An individualized instruction is scaffolding, or instructional support in the form of guides, strategies, and tools which are used during learning to support a level of understanding (Azevedo et al., 2006). This kind of instruction requires that the student has in mind some goals to be achieved against which performance can be compared and assessed. Intelligent Tutoring Systems (ITS) works by emulating aspects of human tutors, such as engaging learners in a dialogue about their knowledge or inferring various characteristics of learners that may be used in order to foster SRL skills. Some authors discussed the role of the instructor in mediating the self-regulation development in these online environments. See Appendix A for further information on this subject. Overall, there are strong learning gains from systems that promote self-reflection, self-regulation and self-monitoring according to a 2009 survey by the U.S. Department of Education on the best practices in online learning (Means et al., 2009) (p.44-45).

2.4.2 Self-Monitoring and Self-Assessment in Online Environments

Self-monitoring is the ability to monitor one’s own performance, plan, and compare with others. This is a key process to the development of self-regulatory strategies. Self-assessment is very effective for learners seeking to improve their knowledge and learning strategy (Shaklee et al., 1997). It comprises of how are the learners to understand the implications of their actions and reason about the assessment process. Research has shown that less competent individuals overestimate their abilities because they lack the metacognitive skills to recognize the error of their own decision (Kruger and Dunning, 1999; McMahon and Luca, 2001). In an experiment, Kruger and Dunning (Kruger and Dunning, 1999) studied the correlation between one’s erroneous views of his or her abilities and his or her cognitive skills. The results show that people without knowledge or wisdom to perform well are often unaware of this fact. They attribute this lack of awareness to a deficit in metacognitive skills. De Crone-Todd et al. (Crone-Todd et al., 2000) support the idea that “effective assessment can play a vital role in appropriately placing students, diagnosing learning problems and progress, improving and enriching teacher performance, and in achieving and maintaining academic standards”.

The use of study aids or tips, for example, is essential to self-regulated learning, but it does not mean that learners are engaged in a metacognitive process or are able to regulate
their own learning, given the passivity nature when dealing with such aids. They may not be enough to trigger a SRL thinking. Conversely, learners who create their own aids, such as memos and annotations about his or her progress, are more likely to be in a metacognitive and self-monitoring process (McMahon and Luca, 2001). In other words, those more effective at self-regulation, produce better feedback or are more able to use the feedback they generate to achieve their desired goals (Butler and Winne, 1995). How to enhance feedback (either self-generated or external) in support of self-regulation has not been fully explored in the current literature (Azevedo et al., 2006). This kind of results, inspired our design process and suggested that Redu interface should have some opportunities to take note during the learners practice. The research on feedback and formative assessment seeks to identify how these processes can help student take control of their own learning, i.e., become self-regulated learners (Nicol and Macfarlane-Dick, 2006). Formative assessment refers to assessment that is specifically intended to generate feedback on performance to improve and accelerate learning (Sadler, 1998). Nicol and Macfarlane-Dick (Nicol and Macfarlane-Dick, 2006) identified ways in which formative assessment and feedback might be organized so as to support self-regulation. They have provided some key principles of good feedback practice that address the cognitive, behavioral and motivational aspects of self-regulation. The good principles of feedback practice are:

1. helps clarify what good performance is (goals, criteria, and expected standards);
2. facilitates the development of self-assessment (reflection) in learning;
3. delivers high quality information to students about their learning;
4. encourages teacher and peer dialogue around learning;
5. encourages positive motivational beliefs and self-esteem;
6. provides opportunities to close the gap between current and desired performance;
7. provides information to teachers that can be used to help shape the teaching.

Of course, the seven principles here listed in (Nicol and Macfarlane-Dick, 2006) are not exhaustive but they provide a good background to implement feedback strategies in a learning social network, as we will discuss in the next chapter.
2.5 Learning in Social Networks

Social networks are environments constituted of people or organizations and relationships among them within a certain domain (Liccardi et al., 2007). Members of these networks interact with their peers and communities. They can have common goals and share a set of practices (Wenger, 1998). Social networks are oriented to promote collaboration among peers. This is an important strategy to help people engage in collaborative learning. Such kind of learning, as we discussed, has its roots in the theories like Vygotsky’s social development which asserts that social interaction plays a fundamental role in the development of cognition (Wertsch, 1985).

A social network is a central element in collaborative learning environments according to a number of researchers in educational theory (or an overview see (Cho et al., 2007)). Learning is a result of both social and collective processes, as it takes place through conversations, network connections, shared practices among distributed learners (Brown and Duguid, 1991) and promotes informal, situated and volunteer learning (Wenger, 1998). Unlike formal learning, in informal learning settings unstructured practices of teaching and learning take place. The individual learner acts in a natural manner according to his or her wills and availability (Livingstone, 2001). Knowledge in this sense is not seen as a static object acquired by individuals, but a reference dynamically constructed through the social collaboration and exchanges embedded in the social networks (Wenger, 1998); (Cho et al., 2007).

Teachers and students start exploring the potential of blogs, media sharing services and social software from third parties, although some of them are not specifically designed for learning. Meanwhile they can be used to aid students and create new learning opportunities. There are potential educational benefits through harnessing new technologies but this potential has not been realized yet. It depends on how easy communities engage in their practices. In the words of Conole (Conole, 2008):

*This fundamental gap between the rhetoric of the potential of technologies and actual practice is a central challenge in current learning design research.*

(p. 3)

The present work intends to bridge this gap by studying and designing aspects of metacognition related to learning performance in a learning social network, Redu.
2.6 Guidelines for Scaffolding Self-Regulation in Social Networks

Azevedo and Hadwin (Azevedo and Hadwin, 2005a) raised the following questions about the efficacy of SRL scaffolds in online environments: (a) What attributes of scaffolding are emphasized? (b) What kind of learning is supported through scaffolding? (c) What or who is the source of scaffolding? (d) What kinds of scaffolds are effective? (e) How are scaffolding needs diagnosed; and (f) What are the future directions and challenges to be faced? (p. 369). The authors briefly review the current literature and suggest adaptive strategies for SRL scaffolding, such as contextual-aids and user feedback.

In a 2009 report released by the U.S. Department of Education (Means et al., 2009) about best practices in online learning, they demonstrate the requirements for learning environments that engage students in appropriate self-regulative activities. Features such as prompts for reflection, self-explanation and self-monitoring strategies have been considered to improve online learning outcomes.

In the present study, we approach the design of a learning social network having in mind a set of features that acts as scaffolds for the self-regulated learning. We relate a SRL statement to one or more SRL scaffolds. For example: the SRL statement “How am I doing?” has the goal of “Monitoring performance” and should scaffold by “Instant feedback about user progress and Peer feedback”. In other words, we suggest facilitators for each of the metacognitive thinking aspect defined.

Each SRL scaffold item was excepted or indirectly inferred from several studies in the literature on CSCL and self-regulation, to name a few (de Carvalho Filho, 2001; Nicol and Macfarlane-Dick, 2006; Pintrich, 1999; Cho et al., 2007; Kitsantas and Dabbargh, 2004; Dabbagh and Kitsantas, 2005; Azevedo and Hadwin, 2005a); Quantitative and qualitative data from reports (Means et al., 2009; Johnson et al., 2010); Case studies (Narciss et al., 2007; Jones et al., 2008; Bannert and Mengelkamp, 2008); SRL inventories (Weinstein C.E. and A.C., 1987; Pintrich and DeGroot, 1990); and other resources mentioned throughout this chapter.

The literature in this field is extensive and provides basis enough for our hypothesis of what kind of features should enable self-regulated learning in a social network. We emphasize that it is not an exhaustive list of all possible metacognitive facilitators. As far as we understand, metacognition is a broad dimension that permeates our activities, emotions, beliefs - and it is not our intention to cover all them. The scaffold items we believe to be most desirable, feasible and viable; the criteria for innovation. The list
2.6. GUIDELINES FOR SCAFFOLDING SELF-REGULATION IN SOCIAL NETWORKS

to be exploited in our learning social network design are outlined in table Table 2.6, as well as their significance (goal) and possible system features. While all those items have their relative importance to the self-regulatory processes, not all can be fully translated to system scaffolds or they simply implies in a change of the learning process. For example: when it asks “I review my notes before the next class”. Other items are out of the scope of this work because they may not exploit much of the social network structure. Items that are related to the way in which teachers deal with students are also out of this work (see Appendix A for a review on the instructor’s role in mediating the self-regulated learning). For example teachers should explain why it is meaningful or important what the students will be learning by giving relative examples (da Silva, 2010). We highlight the issues with this approach in the next chapter.
### Table 2.1 Guidelines for SRL scaffoldings.

<table>
<thead>
<tr>
<th><strong>SRL items</strong></th>
<th><strong>SRL process</strong></th>
<th><strong>SRL Scaffolds</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>What in my prior knowledge will help me with this particular task?</td>
<td>Goal setting</td>
<td>Task instructions; Auxiliary resources</td>
</tr>
<tr>
<td>In what direction do I want my thinking to take me?</td>
<td>Task Strategy</td>
<td>Personal learning objectives; Expected outcomes</td>
</tr>
<tr>
<td>Why am I doing this?</td>
<td>Goal setting</td>
<td>Task Instructions; Task Goals; Competence assessment</td>
</tr>
<tr>
<td>How much time do I have to complete the task?</td>
<td>Time planning and management</td>
<td>Task planning; Estimated time to complete; Chronometer</td>
</tr>
<tr>
<td>How am I doing?</td>
<td>Self-monitoring</td>
<td>Instant feedback about user progress; Peer feedback; Social Comparison</td>
</tr>
<tr>
<td>Am I on the right track?</td>
<td>Self-monitoring</td>
<td>Formative feedback; Performance graph</td>
</tr>
<tr>
<td>How should I proceed?</td>
<td>Strategy selection</td>
<td>Task Instructions; Contextual aids</td>
</tr>
<tr>
<td>What are the rewards for doing this?</td>
<td>Self-motivation</td>
<td>Rewarding mechanism; Social comparison</td>
</tr>
<tr>
<td>How well did I do?</td>
<td>Self-evaluation</td>
<td>Performance graph; Expected outcomes; Social comparison</td>
</tr>
<tr>
<td>Should I adjust the pace depending on the difficulty?</td>
<td>Time planning and management</td>
<td>Task instructions; Estimated time to complete</td>
</tr>
<tr>
<td>Who are doing things that may be interesting to me?</td>
<td>Group Awareness</td>
<td>Activity streams; Blogging; Social Comparison</td>
</tr>
<tr>
<td>What are the resources important for doing this?</td>
<td>Task variables, Person Variables</td>
<td>Auxiliary resources; Activity streams; Forum</td>
</tr>
</tbody>
</table>
By promoting a series of metacognitive opportunities, learners must be able to keep track of their objectives and the employment of selected strategies, and monitor the discrepancy between theirs actual and desired goals.

### 2.7 Chapter Summary

In this chapter we reviewed the state-of-art on metacognition and self-regulated learning necessities to guide our design process. We have seen that metacognition plays a decisive role in learning performance, and has to be considered in the design of learning environments. Social networks can act as a powerful learning mediator among groups. One example is in the constituted problem-based learning situations or peer assistance and comparison. The valuable social skills that support learning are latent in a social network group and it has a positive correlation with self-regulatory gains. Based on those assumptions we sought to define the features of a social network named Redu that may raise the self-regulatory skills from learners. In the next chapter we present a set of features derived from the studies referred in this chapter, and implemented and evaluated in our learning social network: Redu.
Self-Regulated Learning Scaffolding in Social Networks

You need the willingness to fail all the time... You have to generate many ideas and then you have to work very hard only to discover that they don’t work. And you keep doing that over and over until you find one that does work.
—JOHN BACKUS

Recent research findings suggest that teachers and course designers should pay considerable attention to scaffolding student SRL processes occurring on the usage of those tools in order to improve online learning performance (Kitsantas and Dabbagh, 2004; Dabbagh and Kitsantas, 2005; Azevedo and Hadwin, 2005b,a). Scaffolding represents effective mediated teaching and learning strategies to provide novice learners a simplification of the learning process. By default, these supports are gradually removed as students develop autonomous learning strategies (Young, 1993). In online learning environments, scaffolding strategies can be implemented diversely through sets of web interface features that promote goal setting, self-monitoring, self-evaluating, task strategies, help seeking, and time planning and management. While SRL scaffolding has been recently discussed in traditional learning environments (Kitsantas and Dabbagh, 2004; Dabbagh and Kitsantas, 2005; Azevedo and Hadwin, 2005a; Dettori and Persico, 2008); little or no attention is devoted to online social networks contexts. The present study focused in scaffolding SRL in social networks because we believe social networks can remarkably create new styles of interaction that would increase both individual and collective SRL.
skills and effective learning. We have collected self-regulatory items from the current state-of-art on metacognition and self-regulated learning, defined its goals and suggested SRL scaffoldings for them. For example:

**SRL item:** What in my prior knowledge will help me with this particular task?
**SRL process:** Goal setting
**SRL scaffolds:** Task instructions; Auxiliary resources

We next highlight thirteen features in a social network that contribute to the self-regulated learning. Those features were implemented in the Redu network and validated on a control group of students during two weeks (results described in Chapter 4). In the following section, we discuss each one.

### 3.1 Blogging, commenting and forum

Blogging and other authoring tools are already known as adequate medias to enable students to demonstrate their understanding on something by textually synthesizing their knowledge (Cadima et al., 2009; Narciss et al., 2007; Kitsantas and Dabbargh, 2004). Forums can assist learners in setting their goals and strategies to achieve learning task by communicating such goals to the instructor or peers and receiving feedback on the implementation of these goals.

In a survey with 88 first year high school students, Jones (Jones et al., 2008) studied the relationship between peer discussions and self-regulated learning. The students answered questions from the Motivated Strategies for Learning Questionnaire (MSLQ) and reported the perceived frequency of discussions between peers both inside and outside the classroom regarding self-regulated learning. Results suggest that peer interactions relates to students’ self-regulated learning behaviors. In particular, the frequency and substance of peer discussions relates to the self-regulation of learning, especially for students sharing learning strategies with peers and their peer groups. Dabbagh and Kitsantas (Dabbagh and Kitsantas, 2005) studied student interactions within online learning environments and the SRL processes underlying them. One of the findings was that the act of posting one’s work was particularly useful in supporting self-evaluation and task strategies because they could go back and check each others work, evaluate and revise as necessary.

Those authoring tools can also be effective to motivate students to be proactive producers, since students take more time and put in more effort when they are aware that...
3.2 Task Instructions, contextual aids and use policies

These items help learners reflect their own actions of what they should do and what they should not in the network. Task instructions provide information about how to accomplish a task, what resources may be used, time constraints and its goals. By doing so, it can assist learners in organizing the instructional content in meaningful ways.

Contextual aids displays information that assists learners in doing what it is expected them to do by looking at what they have done so far (Figure 3.1). Moreover, the use of graphics, audio, and video can greatly enhance learning by engaging them in alternative forms of processing the content (Kitsantas and Zimmerman, 2006). Use policies seek to prevent undesirable behavior of the students in the online environment, such as insulting their peers and distributing copyrighted content.

![Helpful Tips!]

The more precise information you fill in about the test in Title and Tags, the easier it will be for you and your contacts to find your test.

Figure 3.1 A contextual aid displayed in an info box at wiziq.com

3.3 Prompts for reflection

According to a survey by U.S. Department of Education (Means et al., 2009) a number of researchers examined the influence of promoting aspects of learner reflection in a Web-based environment improved learning outcomes. These studies found that a tool or feature prompting students to reflect on their learning was effective in improving outcomes.

A study by Bannert (Bannert and Mengelkamp, 2008) confirmed that prompting students for metacognitive reflection affected learning performance positively. By means of the thinking-aloud method, students in one group were instructed to read and think
aloud during learning. They had a significant learning performance than the control group (without verbalizing their learning).

Pintrich and coll. (Pintrich and DeGroot, 1990) developed the Motivated Strategies for Learning Questionnaire (MSLQ) to assess student’s motivational orientations and their use of different learning strategies. The questionnaire can be adapted and used for self-reflection. As they complete the MSLQ (or part of it), students receive individualized feedback as to their strengths and weaknesses in each skill identified by Pintrich, namely: goal setting, self-monitoring, self-evaluating, task strategies, help seeking, and time planning and management.

Features such as prompts for reflection, self-explanation and self-monitoring strategies have promised to improve online learning outcomes. However, excessive prompting may be interrupting and intrusive. The prompting should not disturb the learner current task; instead it has to be concise and optional. The learner should choose whether the prompting mechanism is activated or not.

### 3.4 Activity streams

Recently much attention has been paid to activity streams in Social Networks. It’s a feature that enables users to keep track of what others are doing in the network (Figure 3.2). Because of the time-oriented nature, users can have a good perception of the content flow of the network. An interesting application would be, for example, a learner who suggests to a friend an article after seeing that his colleague is watching a lecture in the network. In a learning social network it can:

- Enable social media discovery (learning objects);
- Enable automated content generation from user activity;
- Enable a learner to find new interests, users and learning objects;
- Enable increased community involvement between learners; and
- Inform learners of critical events or those of specific interest.

### 3.5 Resources creation and sharing

Pedagogical tools may include the use of media creation and visualization tools such as presentations, documents, videos, flash and applets that allow learners to synthesize
3.6 Learning profile

The learning profile enables the user to define and plan his or her learning goals; strategies and resources that may be used; and estimated time for completion (da Silva, 2010). It allows other students with similar goals to assist each other and make necessary adjustments on their strategies and goals.

3.7 Lecture notes

Annotations and lecture notes enable users to keep track of their learning process, acting as an auxiliary memory. Those annotations can be either private or public, allowing their sharing or discussion among the peers. Related research on this feature suggest that the frequency and substance of peer discussions inside and outside the class relates to the self-regulation of learning, especially for students sharing learning strategies with peers and their peer groups (Jones et al., 2008).
3.8 Peer discussion and assistance

Peer assistance aims to help users improve their knowledge and skills by linking them with tools and medium that allows to gain rich and broad feedback that would normally be possible in a one-to-one meeting with the instructor. The potential for such discussions is even greater in online social networks.

Kirk and Yuzawa (de Carvalho Filho and Yuzawa, 2001) investigated whether social information can affect Ease-of-Learning (EOL), Judgments-of-Learning (JOL), and Feeling-of-Knowing (FOK) and their accuracy. Participants first learned associated word pairs and made the above-mentioned judgments. Results revealed that the magnitude of the metamemory judgments assessed was significantly affected by the social cues and that participants with a low level of metacognitive ability were more influenced than those with high metacognitive ability. Karabenick (Karabenick, 1996) also confirmed that the presence of colearners’ questions can affect one’s own comprehension judgments. Jones and colleagues (Jones et al., 2008) observed that discussions with peers outside class were related more closely to students’ reported self-regulated learning than discussion with peers inside class.

Providing mechanisms for learner assistance and discussion is essential for the self-regulated learning. For instance, in Livemocha (www.livemocha.com), a social network for language learning, allows users to review and feedback others submissions (Figure 3.3).

3.9 Quizzes and rubrics

In online environments, self-monitoring can be administered online in form of quizzes and simulations. Learners can assess their knowledge through quizzes and simulations available on the internet. In the formative assessment feedback on performance is generated throughout the course of the study rather than at the end of it (summative). This kind of assessment improves and accelerates learning because the learner has immediate response about his error and the learner can review the subject before proceeding (Sadler, 1998; Nicol and Macfarlane-Dick, 2006). Rubrics should be provided to support goal setting. In a study on SRL and online learning environments (Dabbagh and Kitsantas, 2005), students reported that rubrics were particularly useful in supporting goal setting by helping them understand the goals, tasks, and expectations of those assignments. In Redu, an exam is an instruction page followed by a set of questions, each one having
3.9. QUIZZES AND RUBRICS

Figure 3.3 Reviewing a friend submission in Livemocha.
only one correct choice. When answering a question, one question is displayed at once (Figure 3.4).

![Figure 3.4 Answering a question in Redu.](image)

The learner can navigate through the questions. This is important because it helps to select the best strategy, for example with time constraints, learners can chose the questions he or she already know or takes less time to complete. Showing all the questions at once also helps the strategy selection since it is easy to see how many questions are left. Answered questions appear lighter in the navigation bar whereas the current question is highlighted in yellow.

### 3.10 Performance feedback and guidance

Feedback is information about how the student’s learning and performance relates to a set of standards and goals. Kruger and Dunning (Kruger and Dunning, 1999) studied the correlation between one’s erroneous views of his abilities and his cognitive skills. Results showed that people who lack the knowledge or wisdom to perform well are often unaware of this fact. They attribute this lack of awareness to a deficit in metacognitive skills. In technology education, an important source of feedback for students is their success or failure in accomplishing a specific task, for example, the design, construction, evaluation and improvement of artifacts and control systems (Pintrich, 1999; Kitsantas and Dabbargh, 2004; Barak., 2009).

According to Butler and Winne (Butler and Winne, 1995), those more effective at self-regulation produce better feedback or are more able to use the feedback they generate to achieve their desired goals. Grant (Grant and Courtoreille, 2007) studied an application of post-unit quizzes that gives the student the opportunity for additional practice on item
3.11 Reward participation

A rewarding system is a mechanism that recompenses users according to his or her participation in the network in order to motivate users to continue interacting with the
system. Contributions are rewarded with points and medals for being a helpful, active community member. An effective reward system must recognize the intrinsic and extrinsic sources of motivation to the learner (Malone and Lepper, 1987). Reward systems are based on the assumptions of attracting, retaining and motivating people and it also serves as a motivational feedback mechanism. The higher quality contributions a user make to others, the more points he or she gets. The more points a user accrues the more help he or she gets from others and the better his or her status within the community.

The use of this kind of rewarding system has been sometimes controversial in the sense that it may turn user’s attention to become obsessed with points, cheating the system rather than genuinely trying to learn and help their peers. For instance, users might leave useless comments just to see their point totals increase. In Livemocha (www.livemocha.com), a popular language learning social network, people have noticed that some users give inaccurate feedback such as saying the person did well when in fact the submission was riddled with errors. A possible workaround is the implementation of a comment quality rating which would allow users to judge bad or useless comments and therefore assign points accordingly. Nevertheless we believe that the rewarding system is a simple, yet effective motivator in most of cases.

3.12 Graphical information

Kitsantas and Zimmerman (Kitsantas and Zimmerman, 2006) studied how graphing the results can improve learner’s awareness, motivation and strategy selection of learning progress. Students who graphed their results visually showed higher dart skill and stronger
motivational beliefs than participants who did not graph their results. Using techniques from data mining and graphical visualization, it is possible to get a good overview of the whole data, and to recognize any underlying processes, patterns of behavior and even detect unusual cases (Foroughi and Taponecco, 2005). For exemplification, in our learning social network, Redu, we have prototyped two visualizations: Social Activity Graph and Radial Performance Graph described below.

### 3.12.1 Social activity graph

The social activity graph gathers data from the activity streams and displays people (represented as nodes) and their connections with other people and resources. When a user clicks on a node it expands the recent activities and connections of that person.

![Figure 3.6 The Social Activity Graph.](image)

### 3.12.2 Radial performance graph

We have prototyped another kind of visualization for performance assessment. The graphical results are exhibited in a Radial Tree layout, which seeks to distribute the nodes from inner to outer space as shown in Figure 3.7. Nodes are represented as a knowledge field. They are painted according to the learner performance in that field. For example, if a student has a good performance in Physics it will display it green while a bad performance would display it red. An infobox displays a set of statistics, for example...
how many quizzes he or she has taken or how long he or she usually takes to answer a question.

![Graph representing the learner performance in knowledge fields.](image)

**Figure 3.7** Graph representing the learner performance in knowledge fields.

### 3.13 Related work

Several recent studies in CSCL have focused on learner activities in order to create awareness among learners. An interesting meta-analysis in educational technology can be found in a ninety-six page report by U.S. Department of Education (*Means et al.*, 2009) (in particular p. 43-49). We briefly review some of the most prominent works in self-regulation of learning in this section.

#### 3.13.1 Self-regulated learning and learning environments

Weinstein *et. al.* (*Weinstein C.E. and A.C., 1987*) developed the Learning and Study Strategies Inventory (LASSI), a diagnostic tool to measure how students use learning strategies in academic environments - so they can be empowered through interventions. “*It is designed to gather information about learning and study practices and attitudes based on 77 statements related to learning and studying*” (*Weinstein C.E. and A.C., 1987*) (p. 2). It provides assessment in ten learning and studying scales as follows:

- Attitude towards studying and motivation for success;
3.13. RELATED WORK

- Motivation, diligence, self-discipline, and willingness to work hard;
- Use of time management principles for academic tasks;
- Anxiety and worry about school performance;
- Concentration and attention to academic tasks;
- Information processing, acquiring knowledge, and reasoning;
- Selecting main ideas and recognizing important information;
- Use of support techniques and materials;
- Self-testing, reviewing, and preparing for classes; and
- Test strategies and preparing for tests.

These LASSI scales are administered through either paper-based, floppy disk or web-based testing, in which students are generally given both pre- and post-tests to test their progress. The LASSI tool is still widely used over two thousands of institutions over the U.S.

Similarly, Pintrich and DeGroot (Pintrich and DeGroot, 1990) proposed the Motivated Strategies for Learning Questionnaire (MSLQ) for assessing students’ motivational orientations and their use of different learning strategies for a college course. The MSLQ is based on a general cognitive view of motivation and learning strategies, contains two sections. The motivation section consists of 31 items that assess students’ goals and value beliefs for a course. The Learning Strategies section includes 31 items regarding student’s use of different cognitive and metacognitive strategies and 19 items concerning student management of different resources. Sample statements from the questionnaire include “I think I will be able to use what I learn in this class in other classes” and “I think I will receive a good grade in this class”. These statements are rated on a seven-point scale ranging from “very true” to “not true at all”. In the present study, we have applied the MSLQ in order to assess students’ prior self-regulated skills in a pretest evaluation (details in Chapter 4; questionnaire in Appendix C).

Dabbagh and Kitsantas (Dabbagh and Kitsantas, 2005) studied how different categories of Web-based Pedagogical Tools (WBPT) supported the SRL processes and the scaffolding while completing course assignments involving specific learning tasks. The sample surveyed 65 students enrolled in three distributed courses. As expected,
3.13. RELATED WORK

quantitative analyses confirmed that different WBPT supported different SRL processes. In addition, analyses of qualitative data collected proved WBPT were highly effective in activating the use of SRL processes necessary to support specific types of learning tasks required for completion of course assignments.

In Azevedo and Hadwin (Azevedo and Hadwin, 2005a), authors discuss the implications of scaffolding self-regulation in the design of learning environments. The article presents an overview of several challenges to the issue of scaffolding self-regulated learning and metacognition, and derives implications for the design of computer-based scaffolds based on five case studies.

Narciss and his colleagues (Narciss et al., 2007) developed and evaluated two authoring tools that support meta-cognitive activities in web-based learning environment named Study Desk (Figure 3.8). The Study-to-Web Compiler, which supports instructors in combining and integrating multiple learning materials and media into an interface which provides direct and efficient access to all materials and; a media authoring tool, which facilitates the construction and implementation of interactive learning tasks. Interactive learning tasks are solved interactively with the additional aid of multiple-try strategies and informative tutoring feedback if required.

3.13.2 Visualization

Foroughi and Taponecco (Foroughi and Taponecco, 2005) proposed a visualization system for accessing student’s performance. The system mines data from a LMS system and display in a spiraling coordinate system and a Cartesian set allowing for example, the analysis of correlation between time employed to complete the problem sheet and scores. The application can be used to evaluate either class performance or individual student’s performance. However the range of application is very restricted given its linear representation. It’s not easy to make comparisons between individuals from the same spiral, for example. Yet, it requires some training before interpreting the graph.

Mochizuki et. al. (Mochizuki et al., 2005) proposes a visualization method based on Correspondence Analysis to represent discussions in online forums. The method works by mining the posts of each user in the forum and mapping it in a representation where the frequency of each keyword written for each person or group is placed in close proximity to each other. In an application of this method the authors adopted the “bees and flowers” metaphor to explain the co-occurrence relation between the learners and keywords in the discussion, relating the distance between bees and flowers to how strongly each learner relates to each keyword in his/her messages. This approach seems more appropriated to
3.13. RELATED WORK

Figure 3.8 Interface of the Study Desk.
synchronous, real-time environments but the keywords proximity representation is not very elucidative and also leads to a visually polluted graph.

3.13.3 Intelligent tutoring systems

In (Chen, 2009) authors propose a set of SRL-assisted mechanisms for a Personalized E-Learning System (PELS) to enhance learner self-regulated learning abilities and learning performance. In the proposed SRL strategies, four SRL competence indexes based on performance are proposed to assess SRL behavior of individual learners. Two learning performance indexes are proposed to assess the learning performance of individual learners in the PELS assisted by the SRL-assistive mechanisms. Learners can interact with the proposed system via the personalized interactive interface agent and acquire self-regulated learning status automatically from the personalized SRL agent (Figure 3.9). Teachers can monitor the learner status, provide encouragement and hints to individual learners, or establish a Question-Answer (QA) relationship with a learner.

Figure 3.9 Learning interface of the PELS tool.
3.13. RELATED WORK

3.13.4 Social network analysis for learning environments

There has been growing interest in using Social Network Analysis for CSCL and Self-regulation. Social Network Analysis provides statistical tools for analysis the network from the perspective of their relationships. See Appendix B for details about SNA uses in education.

Dettori and Persico (Dettori and Persico, 2008) investigated practices of SRL in an online CSCL community by means of interaction analysis. They defined a set of indicators based on Zimmerman SRL model, such as planning, monitoring and evaluation indicators, which served for coding the messages exchanged by a group of learners.

In (Saltz et al., 2004) authors explore student specific analysis (i.e. analyzing each student individually) through a graphical metaphor to provide the instructor an understanding of the student’s interactions within the class. A directed network graph is mounted according to the number of messages exchanged among students. Active students are shown with a greater shape size (Figure 3.10).

![Figure 3.10 A student social graph (Saltz et al., 2004).](image)

Cadima et al. (Cadima et al., 2009) proposed a social network monitoring system expected to enhance social network awareness in a distributed community. The KIWI (Knowledge Interactions to Work and Innovate) works by asking directly people about their interactions, allowing them to register their interactions while the tool automatically analyses and presents social network information through a visualization tool (Figure 3.11). Explicit social network information is extracted from a database through Social Network Analysis (SNA) techniques.
Figure 3.11 The KIWI system (Cadima et al., 2009).
Despite being in its first steps, the required involvement in the data gathering process creates additional workload for the users that can lead to errors and misuse.

In (Cocciolo et al., 2007) authors used SNA to examine the communicative processes represented in an expansive repository for community-generated intellectual materials. This analysis revealed several phenomena, the most important of them is the extent to which novice learners have come to occupy central roles in terms of facilitating knowledge sharing. Additionally, by examining the extent to which novices are afforded opportunities to share the role of the expert performer, and analyzing the proportion of expert and novice actors who share the role of knowledge facilitator, the study presents a way for researchers to determine the emergence of an online Community of Practice (Wenger, 1998).

Sylvan and Elisabeth (Sylvan, 2006) consider the structure of the Computer Clubhouse social network by looking at email: who emails whom and how much members email people outside their clubhouse. It focuses on the online intranet of the Computer Clubhouse, a network of after-school computer learning centers. Results present a network analysis and graphs that highlight characteristics of the relationships between the youth, such as strength of their ties, gender, and location of emailing dyads.

Martinez et al. (Martínez et al., 2003) present a formative evaluation of social aspects of learning that combines traditional sources of data with computer logs, and integrates quantitative statistics, qualitative data analysis and social network analysis in an interpretative approach. Other researchers have used SNA formatively to improve the design of online learning environments intended to foster collaboration by promoting learner interaction with content (McDonald, 2005).

### 3.14 Chapter summary

In this chapter we proposed a set of scaffolds for fostering self-regulated learning in social networks. Each feature suggested was excepted or inferred from several studies in the literature on CSCL and self-regulation; quantitative and qualitative data from reports; and other resources mentioned throughout this chapter.

We outlined the SRL scaffolds in a social network that contributes to the goal setting, self-monitoring, self-evaluating, task strategies, help seeking, and time planning and management. They were implemented in the Redu learning network and validated on a control group of students during one month. The SRL scaffolds include: 1) Blogging, Commenting and Forum; 2) Task Instructions, 3) Contextual Aids and Use Policies;
We have seen in previous chapters that metacognition plays an important role in self-regulation and it is associated to the learning performance. In this chapter we present Rede Social Educacional (Redu), a learning social network which was designed taking into account the SRL scaffolds described in the previous chapter.

Redu was conceived from two previous field studies on students’ and teacher’s practices in social networks. A survey was administrated by 142 high school students and 8 teachers (see Appendix D). Redu offers a shared workspace where students are encouraged to publish their documents and notes, while the teacher uses it to deliver documents and comments to the class (Figure 4.1). The core philosophy is that the learner should be able to investigate his/her learning process and determine what the consequences of future actions may be.

We begin this chapter by contextualizing the Redu environment. A Pre- post- test asserted the self-regulatory gains by means of an experimental study with 16 students using Redu during one month. We present the instruments, procedures and analysis of this test in this chapter. We later discuss the findings of this study as well as the current trends in the literature.

In order to give a short overview of the Redu network to the reader, a simplified domain model is presented in Figure 4.2. It expresses the relation between the entities in the network. For instance, a user has a learning profile and a student portfolio, containing his or her assignments and publications. A user can join in one or more schools in the network.
4.1 PRE- AND POST- TESTS

Those schools can have lectures, a discussion forum, applications and workgroups. A lecture may contain text and hypermedia such as video, presentation, podcast, interactive text, resources (documents or web sites), exams and personal annotations from students.

4.1 Pre- and post- tests

We investigated the effectiveness of metacognitive features by looking at the evolution of qualitative shifts in the learner’ perceived self-regulatory skills. The aim of the experiment is to investigate the relationship between students’ SRL skills used spontaneously during the learning in social network. More specifically, the goals of our research are to conduct laboratory and classroom research which addresses the following questions:

- Do the scaffolding conditions proposed influence students’ ability to regulate their learning?
- Are the students aware of their level?
- Do students know where to find what he was looking for in the network? and
- Do students perceive what or who can help to accomplish his or her goals?
4.1. Proceedings

Students from Ciências Cognitivas e Tecnologia Educacional (CCTE) group interacted with Redu during one month. Five assignments were required including both individual and team activities that engaged students in exploratory and collaborative learning tasks. These included (1) asynchronous online discussions of course content, (2) reporting activities to the teacher, (3) collaborating creating a course, (4) answering an exam, and (5) helping other students with these assignments. The activities were subjected to multiple measurements of metacognitive skills by means of pretest-posttest method as well as with an off-line retrospective interview.

4.1.2 Pre-test

In order to compute an overall metacognitive score for each participant prior the usage of Redu, students were instructed to take a modified version of MSLQ test Pintrich and DeGroot (1990) (Appendix C) translated to Portuguese. It assured that all participants were within the average metacognitive ability. The MSLQ scales related to the self-regulation of learning are: goal setting, self-monitoring, self-evaluating, task strategies, help seeking, and time planning and management. These scales measure how students manage, or self-regulate and control, the whole learning process through using their...
time effectively, focusing their attention and maintaining their concentration over time, checking to see if they have met the learning demands for a class, an assignment or a test, and using study supports such as review sessions, tutors or special features of a textbook. The results of this evaluation are detailed in Appendix E.

4.1.3 Post-test

Students took a post-test questionnaire (Appendix C) related to the perceived evolution on metacognitive skills: goal planning, self-monitoring, task strategies, self-evaluation, time management and help seeking (summary of results in Appendix F). Each feature suggested is discussed as follows.

**Blogging, commenting and forum**

Students used the commenting and forum mechanisms of Redu mainly for help-seeking (88%) as shown in Figure 4.3. Self-evaluation is also commonly associated because of one’s comparisons with each other.

![Blogging, commenting and forum](image)

**Figure 4.3** Blogging, commenting and forum.

**Task Instructions, contextual aids and use policies**

Task Instructions, Contextual Aids and Use Policies affect the way students formulate their learning strategies as shown in Figure 4.4. They also promote the self-monitoring because students checks if they are acting accordingly.
4.1. PRE- AND POST- TESTS

**Prompts for reflection**

The feature of prompting for students’ reflection in Redu had 100% of impact in the self-evaluation skills according to the graph in Figure 4.5. It should not be a surprise since it intentionally asks the student about their actions.

**Activity streams**

Activity streams displays a timeline of actions from other students in the network and it is constantly updated. In a learning context, it helps students to be aware of others learning strategies or who to approach in case of doubt (Figure 4.6). That should be why they
4.1. PRE- AND POST- TESTS

affect much more task strategies (88%) and help seeking (81%) skills.

Figure 4.6 Activity streams.

Resources creation and sharing

Creating and sharing content can increase SRL skills of task strategies (Figure 4.7) because when doing so, students often change the way they learn.

Figure 4.7 Resources creation and sharing.

Learning profile

According to the graph in Figure 4.8, learning profiles influenced most students’ help-seeking skills (88%).
4.1. PRE- AND POST- TESTS

Figure 4.8 Learning Profile.

Lecture notes

Lecture notes incentivate students to take into account different actions improving their task strategy and self-monitoring skills (Figure 4.9).

Figure 4.9 Lecture Notes.

Peer discussion and assistance

the social discussion and assistance affected the SRL skills differently. It foster help seeking (88%) and task strategies (81%) than others SRL skills Figure 4.10).
4.1. PRE- AND POST- TESTS

Quizzes and rubrics

As expected, quizzes and rubrics affects mostly the self-monitoring and self-evaluation skills Figure 4.11).

Performance feedback and guidance

Besides improving self-monitoring and self-evaluation skills, continuous feedback also forster students’ ability to help seeking Figure 4.12).
4.1. PRE- AND POST- TESTS

**Figure 4.12** Performance Feedback and Guidance.

**Reward participation**

The mechanisms for rewarding participation in Redu fostered the self-monitoring skills in 100% of the participants. It is probably due to the increased interest in the student’s learning progress. **Figure 4.13**.

---

**Figure 4.13** Reward participation.

### 4.1.4 Qualitative data analysis

In order to gather information about learning strategies from students in each of the assignments, a subset of the sample (n=8) were interviewed. The interview raised questions about:
4.1. PRE- AND POST- TESTS

- Attitude towards studying and motivation for success;
- Motivation, diligence, self-discipline, and willingness to work hard;
- Use of time management principles for academic tasks;
- Anxiety and worry about school performance;
- Selecting main ideas and recognizing important information;
- Use of support techniques and materials;
- Self-testing, reviewing, and preparing for classes; and
- Test strategies and preparing for tests.

For assignment 1, the qualitative analyses revealed that collaborative and communication tools were most useful followed by content creation and delivery tools in Redu. Students used the activity streams in Redu for chatting: questioning their colleagues and answering questions from others. The commonly found encondings for their discourse were:

"DÚVIDAS, CHAT" (36), "FACILITAR, ACELERAR" (11), "CHAT AMIGOS PARA ENTENDER ASSUNTOS" (24), "VÍDEO/ANIMAÇÃO FACILITAR APRENDIZAGEM", "PESQUISA/FÓRUM COMPREENDER MELHOR ASSUNTO" (18), "TIRAR DÚVIDAS EMAIL COMPARTILHAR ARQUIVOS" (14), "NOVAS MANEIRAS DE EXPLICAR O CONTEÚDO" (7), "EXERCÍCIOS EXTRAS" (3), "TROCA DE INFORMAÇAO" (41).

In general, students found hard to communicate activities to the teacher (assignment 2). Their main complaints include:

"FALTA RECURSOS VISUAIS" (3), "NOTAS NÃO TÃO PRECISAS" (4), "PROFESSORES NÃO COMPARTILHAM SLIDES" (17), "MONÓLOGO MONÓTONO" (1).

Students preferred create educational content alone rather than the collaborative work for assignment 3. They reported “higher concentration” when studying alone almost unanimously:

"DIFICULDADE EM GRUPO" (13), "MAIOR CONCENTRAÇÃO SOZINHO" (49), "MAIS RÁPIDO E SIMPLES" (3), "NÃO DEPENDER DE OUTROS" (11).

The encondings are originally in Portuguese language
Other students engaged naturally in the collaborative work. Their motivation is generally associated to the synergy created by the group as a whole. Encodings for this group:


For assignment 4, students reported their impressions about their performance in comparison to the group when answering to exams in Redu.


The interview for assignment 5 looked at how the students help their peers using Redu. Most of students did not want to help their peers at all, while others felt comfortably taking this role in the network. Answering questions was reported as being the main activity in helping other students. The popular encodings were:


4.1.5 Summary of findings

The results from this study provided valuable insights for future improvements in Redu. They are outlined as follow.

Assist goal setting and planning
A tutor-like module may help users in setting their goals and planning their learning. We want to avoid excessive input by the user, and techniques of artificial intelligence can be used to diagnose user learning and provide scaffolds accordingly.

Smart feedback
The feedback options in Redu are currently limited to tests results and few stats. Those may be not enough to foster self-evaluation, since users need to know why they performed poorly. Smart feedback enhances exams results by suggesting a set of subjects and actions related to the user performance.

More options when learning in Redu
Varied learning options will enable users to change their learning strategies more effectively. For instance, when attending for a course users could review the subject, ask a
4.2 Discussion

Social-networking is a very controversial subject, especially when it comes to education. In general, social networking has made learning much easier by providing more convenient ways for teachers and students to communicate and share resources with one another. Although there are many positives that have arisen from these advances, there are some negative consequences that have emerged from the new technology as well. In this section we will discuss some aspects raised during the study, their pros and cons.

4.2.1 Instructor’s role in mediating self-regulation

It is important to stress that a great part of fostering students’ self-regulation skills is given by the teaching. Teachers’ feedback is important to develop higher-order cognitive skills and self-beliefs (see Appendix A for a discussion). It is important that teachers provide students with feedback related to all three domains—cognitive, metacognitive and motivational behaviour—rather than focus solely on the transmission of the knowledge domain (Kitsantas and Dabbargh, 2004).
4.2.2 Social network analysis and learning

Learning patterns can be detected through Social Network Analysis (SNA) which may be useful in offering the learner more personalized learning experiences suited to their learning style and needs. For example, the analysis of recordings of meaningful events in the network, such as logins and logouts, access to folders and opening messages, downloads and uploads, and so forth (see Appendix B for a discussion). Social network analysis can be a useful analytical tool to examine complex social processes and outcomes in a learning community (Cho et al., 2007).

4.2.3 Contrast with LMS systems

The Learning Management System (LMS) is a software package that enables the management and delivery of learning content and resources to students. They provide very structured information about courses which often implies in too much input from students. In a social network environment, students are informally engaged in collaborative tasks such as commenting, sharing and bookmarking. The informal settings of social networks promote interaction within communities through a culture of shared practices (Lave and Wenger, 1991).

4.2.4 Effects of social comparison

Although the aforementioned studies suggested social influences on self-regulation, they have some problems. Chambers (Chambres, 1996) found that the social comparison situation had negative effects on high academic achievers. In the same way, in Karabenick’s study (Karabenick, 1996), the effects of colearners’ questions on participants’ comprehension judgments might have been mediated by their metacognitive ability. On the other hand, social interaction and collaborative activities can help learners avoid feelings of isolation and improve motivation and persistence. Changes in the nature of the workplace have put an increased emphasis on teamwork, group cognition, and collective decision making (Means et al., 2009).

4.2.5 Social network adoption by schools and teachers

Traditional academic institutions have generally resisted the influence and increasingly use of social networking activities in the life of their students, but recently, those institutions have discussed the aspects and consequences of this new modes of technological
socialization in education (Johnson et al., 2010).

On the other hand, many educators feel that social networks are detrimental to students’ education. Some argue that blogs may be used as an “instrument of crime” (Kirby and Kallio, 2007). The article examined the legal and ethical ramifications of school administrators using a student’s blog entry to determine whether the student is involved in or planning illegal or dangerous activity, which may affect the school. Pornography, stalking, insulting teachers and faculty, and other crimes can all be related to the use of social networking and blogging. These disadvantageous possibilities that may spring from the use of these social networks ultimately lead educators to refute the idea of using them in the classroom.

4.2.6 Chapter summary

This chapter presented the Redu learning social network focused in fostering student’s self-regulated behavior. We have described the methodology of a field study that was conducted on a pre- and post-test basis along with a retrospective interview for further details about individual’s metacognition usage. The findings highlighted the need for creating more mechanisms for collaboration, learning strategy selection, contextual aids and goal setting and planning. Finally, we discussed some aspects raised during this study related to the use of social networks in education.
Conclusions and Future Work

To acquire knowledge, one must study; but to acquire wisdom, one must observe.
—MARILYN VOS SAVANT

In this work we described a set of scaffolds for Redu, a learning social network focused in promoting the students’ self-regulated learning. The preliminary findings of the experiments indicate that the features suggested are very promising for supporting student self-regulated learning. More enhanced forms of collaborative creation and interaction with learning objects are under development and will be integrated in a future version of Redu.

5.1 Statement of the Contributions

The research done in this work was not intended to be conclusive. Instead, our goal to do an indicative-exploratory study in the field was satisfactorily accomplished. We can outline the main contributions of this work as being:

An analysis of the state-of-art for self-regulated learning in social networks. We conducted an extensive study about the influences of self-regulated learning in online environments and presented an overview of the work found in the literature. In particular, on group influences on self-regulation.

SRL scaffolds for social networks. We defined and implemented a set of SRL scaffolding aimed at fostering the students’ self-regulated behavior in a social network.
A study to validate the proposed solution. This dissertation also presents a case study performed on a pre- and post- test basis along with a retrospective interview.

5.2 Limitations and Future Work

The SRL scaffoldings suggested roughly matched what our intuition indicated. We are planning to introduce some other assignments in the evaluation that will be able to capture more information about SRL processes when collaborating on a lecture, discussing topics, and evaluating an educational content. In particular we would like to add further support to the teacher in mediating student’s self-regulated behavior. In the present work we do not distinguished the teacher from the student because in this initial version of Redu, all participants can be both teacher and student.

More formal procedures with larger sample remains for future work. Questionnaires from both phases will be analyzed with the aid of inference statistics. It is likely that such a project would reveal new research problems - for example, it may be fruitful to investigate strategies of group learning and their influences on self-regulation. In addition, future analysis will investigate specific effects on long term self-regulation.

5.3 Concluding Remarks

Although the scaffolds were designed with a special focus on the self-regulation of learning, we believe they are helpful in other learning dimensions such as the cognitive itself and the motivational. The SRL fostering in social networks does not limit to the scaffoldings suggested; other features such as collaborative tags, rating and bookmarking may well promote the self-regulation of learning. We opted to a small set of features which we could develop and evaluate relatively easy.

Finally, there’s a increasing influence of new technologies in education, however, we must never forget that learning and the self-regulation is both a basic cognitive and social process, and that education cannot be entirely replaced by technology.


Appendices
Instructor’s Role in Online Learning Environments

Some authors discussed the role of the instructor in mediating the self-regulation development in online environments. For example, Willis (Willis, 2008) believes that instructors in online courses faces extra challenges such as to identify student’s needs, adapting teaching style to a diverse audience with little or no contact with the audience.

Kitsantas and Dabbargh (Kitsantas and Dabbargh, 2004) highlights the importance of a range of competencies necessary to the instructor to deal with self-regulation development in web-based environments. The competences are: interpersonal communication and feedback, promoting interaction, administrative and support service, collaboration and teamwork, knowledge of conducting a needs assessment, understanding new learning pedagogical tools and their impact on learners, and developing a perspective of thinking.

To Dettori and Persico (Dettori and Persico, 2008) “the task of educators is to acknowledge, cultivate, exploit and enhance the metacognitive capabilities of all learners”. Teachers should support students in how to recognize and appreciate links between their study behaviors and learning outcomes (Dettori and Persico, 2008).

Wilson (da Silva, 2010) identified a set of requirements for learning environments in order to promote the self-regulated learning in adults using those systems. He states that most systems were not designed with a focus on the teacher and, on the other hand, teachers lack the necessary skills to assess the value of different technologies to incorporate them into their teaching practice.
Applications of Social Network Analysis in CSCL

Social network analysis (SNA) is a sociological paradigm to analyze structural patterns of social Relationships (Wasserman and Faust, 1994). SNA focuses on the relationship between individuals (as opposed to the individuals themselves or the actual content of the information exchanged between individuals). SNA can be used to describe influence, group dynamics and collaboration in learning networks, for example allowing researchers to understand how ideas move through a network through a process called diffusion of innovation. SNA has been used to shed light on several Computer Supported Collaborative Learning (CSCL) contexts. Most of these studies have focused on understanding the dynamics of the class. Tomsic and Suthers (Tomsic and Suthers, 2005) used SNA to discover and describe the social relationship among actors in social networks, and to study the influence on the function of groups as well as individual attributes in the group. In the perspectives of collaborative learning, the relationships refer to information communication, knowledge sharing, and trust among students.

Study suggests that Social Network Analysis can be a useful also as a metacognitive tool, allowing students or teacher to perceive the actual state of the network and engage in a sort of interaction (Wang and Li, 2006). Many researchers try to explore the elements influencing knowledge building, such as abilities of self-control, individual responsibilities, consciousness of sharing knowledge and skills of collaborative communication, etc. (William R. Penuel and Hoadley, 2006). SNA as a methodology has been applied in evaluation programs in order to promote greater teacher collaboration as a means to improving teaching and learning. interaction analysis (Dettori and Persico, 2008), and collaborative forms of evaluating student work (William R. Penuel and Hoadley, 2006). Cho et al. (Cho et al., 2002) states that SNA can be conducted during semester to identify
central or peripheral members, and this information might be helpful to redesigning social infrastructures in a learning community. However, such approach has sometimes been criticized for focusing merely on the structural aspects of the network while disregarding the quality of the process. More qualitative approaches have been taken to analyze the collaborative interactions in more meaningful, contextualized ways (Cho et al., 2002).

SNA is commonly employed as a complementary technique. For example, Kimmerle et al. (Kimmerle et al., 2009a) used SNA along with content analysis to demonstrate that changes of the content orientation of related Wikipedia (www.wikipedia.org) articles were accompanied by similar changes in the orientation of the users who were involved. The development of this co-evolution was illustrated by monitoring how a Wikipedia page on schizophrenia changed in the course of time. At the same time a closer look was taken on the development of the views of participating authors. According to them, by co-working on a shared artifact (the article) people engage in the process of assimilation and accommodation that ultimately leads to new knowledge creation. We suggest the use SNA as a complementary method of self-group-monitoring, by using the user interaction in the system to reflect the learner’s participation and to encourage self-regulatory activities.
C.1 Motivated Strategies for Learning Questionnaire

Please rate the following items based on your behavior in this class. Your rating should be on a 7-point scale where 1= not at all true of me to 7 = very true of me.

<table>
<thead>
<tr>
<th>Motivated Strategies for Learning Questionnaire (1/3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I prefer class work that is challenging so I can learn new things</td>
</tr>
<tr>
<td>2. Compared with other students in this class I expect to do well</td>
</tr>
<tr>
<td>3. I am so nervous during a test that I cannot remember facts I have learned</td>
</tr>
<tr>
<td>4. It is important for me to learn what is being taught in this class</td>
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<tr>
<td>5. I like what I am learning in this class</td>
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<tr>
<td>6. I’m certain I can understand the ideas taught in this course</td>
</tr>
<tr>
<td>7. I think I will be able to use what I learn in this class in other classes</td>
</tr>
<tr>
<td>8. I expect to do very well in this class</td>
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<tr>
<td>9. Compared with others in this class, I think I’m a good student</td>
</tr>
<tr>
<td>10. I often choose paper topics I will learn something from</td>
</tr>
</tbody>
</table>

Table C.1 Motivated Strategies for Learning Questionnaire (1/3).

<table>
<thead>
<tr>
<th>Motivated Strategies for Learning Questionnaire (2/3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. I am sure I can do an excellent job on the problems and tasks assigned for this class</td>
</tr>
<tr>
<td>12. I have an uneasy, upset feeling when I take a test</td>
</tr>
<tr>
<td>13. I think I will receive a good grade in this class</td>
</tr>
<tr>
<td>14. Even when I do poorly on a test I try to learn from my mistakes</td>
</tr>
<tr>
<td>15. I think that what I am learning in this class is useful for me to know</td>
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<tr>
<td>16. My study skills are excellent compared with others in this class</td>
</tr>
<tr>
<td>17. I think that what we are learning in this class is interesting</td>
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<tr>
<td>18. Compared with other students in this class I think I know a great deal about the subject</td>
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<tr>
<td>19. I know that I will be able to learn the material for this class</td>
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<tr>
<td>20. I worry a great deal about tests</td>
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<tr>
<td>21. Understanding this subject is important to me</td>
</tr>
<tr>
<td>22. When I take a test I think about how poorly I am doing</td>
</tr>
<tr>
<td>23. When I study for a test, I try to put together the information from class and from the book</td>
</tr>
<tr>
<td>24. When I do homework, I try to remember what the teacher said in class so I can answer the questions correctly</td>
</tr>
<tr>
<td>25. I ask myself questions to make sure I know the material I have been studying</td>
</tr>
<tr>
<td>26. It is hard for me to decide what the main ideas are in what I read</td>
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<tr>
<td>27. When work is hard I either give up or study only the easy parts</td>
</tr>
<tr>
<td>28. When I study I put important ideas into my own words</td>
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<tr>
<td>29. I always try to understand what the teacher is saying even if it doesn’t make sense</td>
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<tr>
<td>30. When I study for a test I try to remember as many facts as I can</td>
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</tbody>
</table>

**Table C.2** Motivated Strategies for Learning Questionnaire (2/3).
### Motivated Strategies for Learning Questionnaire (3/3)

<table>
<thead>
<tr>
<th>Question</th>
<th>Options 1</th>
<th>Options 2</th>
<th>Options 3</th>
<th>Options 4</th>
<th>Options 5</th>
<th>Options 6</th>
<th>Options 7</th>
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</thead>
<tbody>
<tr>
<td>31. When studying, I copy my notes over to help me remember material</td>
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<td>32. I work on practice exercises and answer end of chapter questions even when I don’t have to</td>
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<td>33. Even when study materials are dull and uninteresting, I keep working until I finish</td>
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<td>34. When I study for a test I practice saying the important facts over and over to myself</td>
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<td>35. Before I begin studying I think about the things I will need to do to learn</td>
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<td>36. I use what I have learned from old homework assignments and the textbook to do new assignments</td>
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<td>37. I often find that I have been reading for class but don’t know what it is all about</td>
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<td>38. I find that when the teacher is talking I think of other things and don’t really listen to what is being said</td>
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<td>39. When I am studying a topic, I try to make everything fit together</td>
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<td>40. When I’m reading I stop once in a while and go over what I have read</td>
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<td>41. When I read materials for this class, I say the words over and over to myself to help me remember</td>
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<td>42. I outline the chapters in my book to help me study</td>
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<td>43. I work hard to get a good grade even when I don’t like a class</td>
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<tr>
<td>44. When reading I try to connect the things I am reading about with what I already know</td>
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*Table C.3* Motivated Strategies for Learning Questionnaire (3/3).
C.2 Redu SRL Questionnaire

Rate each self-regulatory learning process (SRL) presented below, on a scale from strongly agree to strongly disagree, by thinking about the degree to which each of the following Redu features supported these processes. Place a check in the appropriate box next to each process.

![Questionnaire Table]

Figure C.1 Example of the questionnaire to assess the SRL skills in each suggested scaffold.
Redu is a learning social network focused in the creation, sharing and collaboration of educational resources. Redu was conceived from two previous field studies on students’ and teacher’s practices in social networks related to metacognition. An initial survey was administrated by 142 high school students and 8 teachers, between male and female aged 15 to 17 years old. The results are briefly described in the following sections.

### D.1 Online Social Networks Usage

In this section of the questionnaire we sought to find out what are the popular online resources and how students use them to learn.

![Figure D.1 Internet usage for learning](image)

---

1. The questionnaire allowed multiple choices.
2. The questionnaire is in the Portuguese language.
According to the answers, sharing documents (83%) is an important component of the online learning practice along with communication (77%) and questioning colleagues (82%) (Figure D.1).

**Figure D.2** Online tools usage

Results show that Chat and Web search (>74%) are the preferred tools in the learning activity (Figure D.2).

**Figure D.3** How online chats are used for learning

Most students use chat applications to make questions (88%) and share files (79%) with their peers (Figure D.3).

**D.2 Parents Supervision**

Parents can greatly affect one's learning activities, as we see in the following questions.
In general, most parents act only checking school grades (71%), while only a few really help during learning activities (23%) (Figure D.4).

Only 16% students would not accept parents interference in their studies (Figure D.5).

D.3 Teachers and School

Teachers and schools are protagonists of student’s learning. In this section we investigated the resources students commonly use for learning at school and from teachers. There is a huge percentage of students who uses internet services at school (91%), followed by online slide sharing services (68%) (Figure D.6). Most students has wide access to their teachers either in person (45%) or by email (44%) (Figure D.7).
Figure D.6  School online resources usage

Figure D.7  Communication with teachers
D.4 Learning Practices

Understanding students’ learning practices provides us insights about the use of metacognitive skills by the students.

Surprisingly for us, a great part of the students prefer study alone (74%) as opposed to those who study in groups (15%) (Figure D.8).

One’s ability to learn and apply the knowledge in day to day is how most students evaluate their cognitive skills (59%) (Figure D.9).

Figure D.8 School online resources usage

Figure D.9 Self-assessment

Figure D.10 Students teaching activities
When asked if they had opportunity to teach other students 77% answered yes. Most teaching activities are related to the explanation to colleagues, share answers from exercises and send links of educational web sites (Figure D.10).
Pre-test Results

A subset of Motivated Strategies for Learning Questionnaire (MSLQ) (Appendix C) was administrated by 16 undergrad students between male and female aged 22 to 27 years old. The students rated the following items based on his or her behavior in this class prior to the usage of Redu. The rating should be on a 5-point scale where 1 = not at all true of me to 5 = very true of me. The results are illustrated in the following graphs.

![Figure E.1](image)

**Figure E.1** It is important for me to learn what is being taught in this class.
Figure E.2 Compared with others in this class, I think I’m a good student.

Figure E.3 Even when I do poorly on a test I try to learn from my mistakes.

Figure E.4 When I study for a test, I try to put together the information from class and from the book.
Figure E.5  When I do homework, I try to remember what the teacher said in class so I can answer the questions correctly.

Figure E.6  I ask myself questions to make sure I know the material I have been studying.

Figure E.7  It is hard for me to decide what the main ideas are in what I read.
Figure E.8  When I study I put important ideas into my own words.

Figure E.9  When I study for a test I practice saying the important facts over and over to myself.

Figure E.10  Before I begin studying I think about the things I will need to do to learn.
Figure E.11  I often find that I have been reading for class but don’t know what it is all about.

Figure E.12  I find that when the teacher is talking I think of other things and don’t really listen to what is being said.

Figure E.13  When I’m reading I stop once in a while and go over what I have read.
Figure E.14 I outline the chapters in my book to help me study.

Figure E.15 I work hard to get a good grade even when I don’t like a class.

Figure E.16 When reading I try to connect the things I am reading about with what I already know.
The students were instructed about metacognitive skills and rated each self-regulatory learning process (SRL) presented below, on a scale from strongly agree to strongly disagree, by thinking about the degree to which each of the following Redu features supported these processes (see Appendix C for a sample). The results are discussed in Chapter 4.

**Figure F.1** Blogging, commenting and forum.
**Figure F.2** Task Instructions, Contextual Aids and Use Policies.

**Figure F.3** Prompts for Reflection.
Figure F.4 Activity streams.

Figure F.5 Resources creation and sharing.
Figure F.6 Learning Profile.

Figure F.7 Lecture Notes.
Figure F.8 Peer discussion and assistance.

Figure F.9 Quizzes and Rubrics.
Figure F.10  Performance Feedback and Guidance.

Figure F.11  Reward participation.
Figure F.12 Graphical Information.
Dissertação de Mestrado apresentada por Cássio de Albuquerque Melo à Pós-Graduação em Ciência da Computação do Centro de Informática da Universidade Federal de Pernambuco, sob o título “Scaffolding of Self-Regulated Learning in Social Networks”, orientada pelo Prof. Alex Sandro Gomes e aprovada pela Banca Examinadora formada pelos professores:

Prof. Fernando da Fonseca de Souza
Centro de Informática / UFPE

Prof. Romero Tori
Escola Politécnica / USP

Prof. Alex Sandro Gomes
Centro de Informática / UFPE

Visto e permitida a impressão.
Recife, 16 de junho de 2010.

Prof. Nelson Souto Rosa
Coordenador da Pós-Graduação em Ciência da Computação do Centro de Informática da Universidade Federal de Pernambuco.