

**Super
RED**

Supporting
Self Regulated Learning
In Digital & Remote Education

A GUIDE FOR TEACHERS ON SELF-REGULATED LEARNING IN TECHNOLOGY ENHANCED LEARNING ENVIRONMENTS

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1 INTRODUCTION

This document introduces the concept of Self-Regulated Learning (SRL) and focuses on how teachers who acknowledge the importance of developing their students' SRL skills can design their own teaching interventions in such a way as to maximize the opportunities for students to self-regulate. In fact, since practicing SRL is generally regarded as the best way to develop SRL skills, fostering SRL practice is at the core of any teaching strategy with this aim. Technology plays an important role in this development process, in that its use can be an enabling factor but also, in some cases, a hindering factor. Hence, the document also discusses the relationship between SRL and Technology Enhanced Learning Environments (TELEs) and how teachers and students can harness technology affordances for SRL.

The document mostly addresses teachers and practitioners. Hence, its aim is not to provide in-depth competences on SRL but, rather, to summarize the main theories and ideas developed around this concept in order to support its understanding and awareness of its importance, thus encouraging teachers to apply principles of learning design to foster learners' SRL, especially in TELEs.

The document is structured as follows. After this introduction, the second section is dedicated to SRL as a general concept: it defines the term and discusses its three main components: the cognitive/metacognitive, the emotional/ motivational and the behavioural one. The subsequent section discusses one of the most well-known models of SRL: the cyclic model of self-regulation proposed by Zimmerman (1998). The third section discusses the importance of SRL in different learning contexts. The fourth section illustrates the principles that allow to design learning paths and/or environments that facilitate self-regulation. Based on these premises, the fifth and last section, dedicated to the relationship between SRL and TELEs, goes deeper into how the learning design principles mentioned above can be put into practice in online or blended contexts, with particular attention to the case of socio-constructivist learning processes.

This document is freely inspired to a similar document published in Italian a few years ago (Persico, 2016), which has been herein translated, updated and extended for the purposes of the SuperRED¹ Erasmus+ Project. To foster the readers' reflections about its content, the document has been endowed with so called "reflection prompts", that is, questions that readers are invited to answer, possibly in groups, to assess and consolidate their understanding of each section, or also to anticipate contents dealt with in the subsequent ones. This expedient is generally very useful, but in this case it is particularly appropriate because SRL is a term that many teachers may have never heard of, while most of them have already come across related concepts (such as meta-cognition, motivation, personalisation, self-efficacy², etc.) and they may have even tried to foster their students' "learning to learn" skills. However, usually, the focus is on learning strategies or cognitive and metacognitive skills, while emotional, motivational and behavioural components of SRL are often

¹ The SuperRED project (<https://www.superred.eu/>) is funded by Erasmus+ KA2. Project Reference 2021-1-IT02-KA220-SCH-000034442

² Self-efficacy is the belief that one is capable to perform a given task or achieve a given goal (Bandura, 1994)

underestimated or misunderstood. On the other hand, those teachers who have already explicitly come across the notion of SRL will hopefully find in this document several stimuli to further their competence in taking advantage of technological tools to design SRL-oriented teaching interventions.



2 THE CONCEPT OF SELF-REGULATED LEARNING

Self-Regulated Learning (SRL) is the process through which individuals actively and consciously monitor, regulate and control their own learning from the cognitive and meta-cognitive, emotional and motivational, and behavioural points of view. In this effort, they are guided and constrained by their goals and contextual features (Boekaerts, Pintrich, Zeidner, 2000; Shunk & Zimmerman, 1998; Zimmerman & Shunk, 2001; Pintrich, 2000). The concept has been widely investigated in the last decades, with theoretical studies concerning models of how skilful self-regulators master their learning process (Panadero, 2017) and studies focusing on specific aspects, such as meta-cognition (Azevedo & Alevén, 2013) or motivation (Zimmerman, 2008). The role technology can play in SRL has also been thoroughly investigated (Azevedo, 2005; Edisherashvili, Saks, Pedaste & Leijen, 2021; Pérez-Álvarez, Maldonado-Mahaud, & Pérez-Sanagustín, 2018).

2.1 Cognitive and metacognitive aspects

Controlling cognitive aspects means, making decisions about what to study and how or when to do it, or consciously choosing strategies to remember information or terms, understand, solve problems and assess one's own learning. Metacognitive aspects³, on the other hand, concern all those processes that have to do with reflection, understanding, analysis and management of one's own cognitive processes.

So, for example, controlling cognitive aspects means using memorisation or self-assessment strategies (like inventing rhymes to memorize names or working out ways to check math problems' results), while controlling one's own learning from the metacognitive point of view means, for example, realizing that one's comprehension of a text or a lesson is poor, and take decisions about what could be done to improve it.

2.2 Motivational and emotional aspects

Controlling motivational and emotional aspects, on the other hand, entails knowing how to manage and regulate one's emotions and maintaining an adequate degree of investment in terms of cognitive commitment. Both *self-efficacy*, i.e. the belief that one is able to perform a given task or achieve a given goal, and the ability to manage negative emotions that may interfere with learning (such as anxiety or disappointment), play an important role in this context. Self-regulated learners are generally highly motivated and are able to enhance and maintain their motivation in time. In this regard, it should be said that intrinsic motivation, i.e. that linked to a genuine interest in what one is studying or to the pleasure/satisfaction of learning it, is certainly of fundamental importance in SRL. However, extrinsic motivation, i.e. motivation springing from the desire to obtain a certain type of result (e.g. a good grade, or to obtain a degree) or to avoid something unpleasant (such as making a bad impression), or even the motivational elements induced by playful approaches such as game-based learning or gamification, can also play an important role in SRL (Passarelli et al, 2019).

³ For a more accurate definition of the concept of metacognition, see Martínez (2006).



Thus, self-regulated learners are often driven by genuine interest in content and/or desire to succeed in reaching their long term goals, but they often also sustain their motivation by trying to make learning as pleasant as possible in several ways (e.g. by studying with a friend, or inventing games or strategies that make a task more interesting, especially when their motivation originates from factors that are not inherent to the content). For example, a medical school student may be highly motivated to become a good doctor, but this doesn't necessarily mean he or she is intrinsically interested in learning the names of all the bones in the human hand. Some authors (Pintrich, 2000), use the expression "goal orientation" to distinguish between different roles motivation can play in SRL. Possible motivational goals may be achieving mastery of content, concluding a course of study and getting a qualification, but also pleasing a teacher/parent or proving one's capacities in a competitive way.

2.3 Behavioural aspects

Among the behavioural aspects, Zimmerman (2008) mentions the effort put into performing a task or achieving a goal and the actions aimed at controlling the learning environment. Regarding the first aspect, self-regulated learners know when to insist on doing a task or to give up and seek help, and they understand when they can move on, or need a break or must change their learning strategies because results are not satisfactory. Regarding control of the learning environment, this can be done by eliminating or avoiding distracting factors, or by trying to understand what the teacher or the learning environment requires in order to meet their expectations.

2.4 An operational definition

On the basis of the above, we can say that self-regulated learners are those who:

- know what they want to learn and why;
- plan their own learning process;
- consciously choose their study, understanding and problem-solving strategies, possibly by adapting those learned in other areas;
- do not get discouraged by failures but develop strategies to overcome them by controlling negative emotions;
- monitor the results obtained and, if necessary, adjust the strategies adopted so as to achieve their objectives;
- change their original plans by adapting the goals, the time devoted to learning, or the strategies adopted taking into account their previous results;
- are able to learn independently, but also to learn from and with others, seeking help when necessary.

According to Zimmerman, SRL "is not a mental ability, such as intelligence, or an academic skill, such as reading proficiency; rather, it is the **self-directed process** through which learners transform their mental abilities into academic skills" (Zimmerman, 1998, p.2). Hence, **SRL is context-dependent** (Boekaerts, 1999): the same individual, in different contexts, is able (or not) to mobilise the skills needed to learn, according to their motivation, different boundary conditions, etc. This explains why some students, who are able to effectively self-regulate their learning in one area (e.g. foreign languages), may fail in the

study of very different disciplines, such as mathematics. The strategies needed to self-regulate when studying these two disciplines are very different, and attempting to apply those that work in one area to another may lead to failures.

Reflection prompts

Think about your children, your students, and other people you know. Choose some examples of how effectively or ineffectively they self-regulate for each of the three aspects: cognitive/metacognitive, motivational/emotional and behavioural. _____



3 SRL: HOW IT HAPPENS

Educational psychologists have proposed different models of how SRL takes place (Panadero, 2017). In Fig. 1, we report one of the most well-known: Zimmerman’s cyclic model, dating back to 1998. According to this model, SRL is a cyclic process consisting of three phases: **Forethought**, **Performance** and **Self-Reflection** (Zimmerman, 1998; 2008). These three phases are all needed during the process of self-regulation and the last one, self-reflection, normally stimulates a further phase of *Forethought* that takes into account what happened in the previous cycle and leads to an adaptation of the strategies adopted in previous cycles to improve the next Forethought and Performance phases. The cyclic process will repeat itself until the learner decides - in the self-reflection phase - to interrupt the cycle, either because satisfied with the result, or for other reasons.

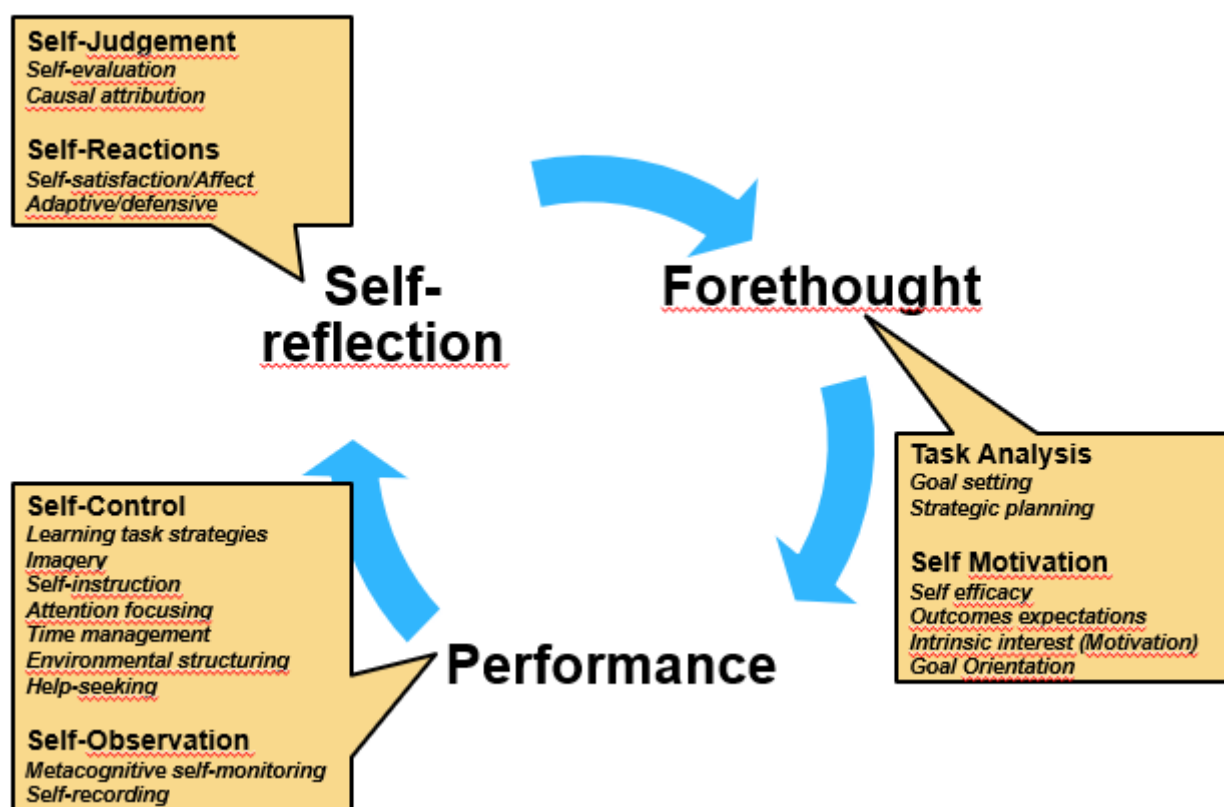


Figure 1: Self-regulated learning as a cyclical process⁴ (Zimmerman, 1998; 2008)

Each phase can be further analysed by distinguishing the sub-processes shown in Fig.1. The **forethought** phase focuses on *task analysis* and *self-motivation* beliefs. The former includes setting the goals and an initial plan of the learning strategies to be used. The latter

⁴ The sub-processes of each phase have been integrated based on the content of an interview with Barry Zimmerman by Science watch: [Barry Zimmerman Discusses Self-Regulated Learning Processes - ScienceWatch.com - Clarivate](https://www.sciencewatch.com/clarivate/barry-zimmerman-discusses-self-regulated-learning-processes/)

concerns a first assessment of one's own ability to achieve the objectives (*self efficacy*) and of the expected outcomes, as well as the appraisal of the learner motivation and "goal orientation", i.e. whether the learner is moved by desire to master content for intrinsic interest or rather by motivations of a more competitive nature.

The **performance** phase entails *self-control* and *self-observation*. The former includes monitoring of performance in terms of adapting the learning strategies when they turn out to be sub-optimal, imagery (i.e. using imagination or other creative strategies to remember something)⁵, managing time, configuring and personalising the learning environment, making sure to avoid distractions and focus the attention on the learning tasks and, very importantly, making decisions about help-seeking. It should be noted that help-seeking refers not only to the explicit request for help from the teacher, an expert or other students, but also to looking for alternative sources of information with respect to those already available to the student, which he or she can use to improve understanding or acquire deeper/wider knowledge. In the internet age, for example, searching for explanations or more in-depth texts on the net can be considered a *help-seeking* activity. Self-observation consists in self-recording (keeping track of one's own learning process) and metacognition, i.e. reflection, understanding, analysis and management of one's own cognitive processes. The latter is the bases for effective adaptation of the learning process.

Finally, the **self-reflection** phase concerns self-judgement and self-reactions. These comprise an evaluation of the learning process that has taken place, including self-evaluation, the identification of the causes of failure⁶, the emotional reactions towards oneself (positive, such as satisfaction, or negative, such as anger) and the identification of the opportunity to adapt some approaches that have proved to be ineffective. Adaptation is particularly important self-regulated behaviour, as opposed to self-defensive reactions, which normally lead to finding justifications for the choice of ineffective strategies without trying to improve them.

Reflection prompts

For each of the three phases of Zimmerman's cyclic model, what can teachers do to foster them? Think of as many examples as you can. _____

⁵ An example of imagery is when, to learn a word in a foreign language, the learner finds similarities with something more familiar in his/her own language.

⁶ Self-regulated individuals tend to attribute failures to causes that can be remedied, such as having adopted unsuitable strategies. Conversely, attributing failures to causes that cannot be remedied (e.g., "I am helpless in math") may trigger unproductive remedial actions, such as trying to memorise without even trying to understand, when understanding is necessary.



4 SRL: WHY IT MATTERS

SRL has been studied in relation to several aspects, including the following:

- Learning outcomes (Zimmerman, 1990; Shunk & Zimmerman, 1998);
- Motivation (Zimmerman, Bandura & Martinez-Pons, 1992);
- Ability to transfer skills from one area to another (Boekaerts, 1999);
- Problem-solving skills (Paris & Paris, 2001);
- Collaborative learning (Delfino, Dettori, Persico, 2010; Dettori & Persico, 2008);
- Professional development and life-long learning (Littlejohn, Milligan, & Margaryan, 2012);
- The role of formative assessment and feedback (Nicol & Macfarlane-Dick, 2006);
- Teacher training (Delfino, Dettori, Persico, 2010; Persico, Milligan, & Littlejohn, 2015);
- Technological tools that can support its practice (Manganello, Pozzi, Passarelli, Persico, & Dagnino, 2021; Segaran & Hasim, 2021).

These studies have deepened the link between the concept of SRL and other important aspects in learning. SRL, for example, is strictly related to motivation (Zimmerman, 2008) and there is evidence that self-regulated learners achieve better learning outcomes than those who have poor control of their learning processes (Mega, Ronconi, & De Beni, 2014). While Zimmerman's model of SRL is one of the most well-known, other authors have proposed alternative ones (Pintrich, 2000, Panadero, 2017) or frameworks useful to study SRL in specific contexts, like professional learning (Milligan, Littlejohn, & Margaryan, 2014) or collaborative learning (Järvelä, & Järvenoja, 2011; Hadwin, Järvelä, & Miller, 2017). In particular, it is worth mentioning three learning contexts of primary importance and their relation to the concept of SRL: the school context (Boekaerts & Corno, 2005), higher education (Broadbent & Poon, 2015) and life-long learning, i.e. adult learning in vocational or informal learning contexts, including the workplace (Maina & González, 2016; Milligan, Littlejohn and Margaryan, 2014). In the following, we briefly discuss the meaning and importance of SRL in these three very broad contexts, to discuss the different viewpoints that should be adopted in relation to the maturity of the students. However, a basic recommendation that applies to all of the three contexts is that designers and teachers should not underrate the importance of the aim of developing learners' SRL skills in any of such contexts, as SRL development is a life-lasting process, like learning.

4.1 SRL at school

"Learning should not only take us somewhere; it should allow us later to go further more easily" (Bruner, 2009, pp.17)

According to Boekaerts (1997), there is general agreement that learning is an active and constructive process requiring students' active participation in the creation/construction of new knowledge based on their prior knowledge and their previous experience. From this point of view, one of the most important objectives of schools must be to accompany children on a path that leads them to 'learn to learn'. Bruner's quote, even if it does not

explicitly refer to SRL, can be interpreted in this sense. However, it must be taken into account that self-regulatory capacities are far from 'monolithic', in the sense that an individual may demonstrate good SRL skills in one context and poor ones in another (of course, these skills should be considered in relation to students' age and complexity of the content). As mentioned above, learning difficulties in one subject may be linked to attempts to use learning strategies that are inappropriate to that discipline, strategies that may be much more effective in other areas.

Thus, one of the main goals of education should be to provide pupils with the ability to construct new knowledge by self-regulating their own learning appropriately, in different contexts.

4.2 SRL at university

The university teacher often expects his or her students to be quite capable of self-regulation, at least in the study of the disciplines they themselves have chosen to study, on the assumption that the choice was made with their own abilities and interests in mind.

However, the assumption that university students are able to self-regulate their learning is often misleading, and *drop-out* rates from universities are a litmus test of this fact. In the first place, the choices made by students have probably been dictated by a set of considerations including their perceived aptitude for studying the disciplines in question, but not limited to this. However, the idea that a student has of a given discipline is usually based on their high school experience and may not correspond to what he or she will face at university. Finally, university studies often require different, or greater, SRL skills than those that are sufficient at school level, because university teachers are committed to develop high level professional skills, more than educating their students. However, although disciplinary learning objectives may be prevalent in university education, university teachers should bear in mind that the development of SRL skills in view of professional life and life-long learning is important in higher education too, and that taking the necessary SRL skills for granted could turn out to be a mistake.

4.3 SRL and Life Long Learning

Needless to say, the link between SRL and Life Long Learning is very strong. In fact, we can say that there can be no Life Long Learning without SRL skills. To be more precise, when we talk about Life Long Learning it is perhaps more appropriate to use the term Self-Directed Learning (SDL), rather than Self-Regulated Learning. Although the distinction between SRL and SDR (Pilling-Cormick & Garrison, 2007; Loyens, Magda, Rikers, 2008) is rather blurred and falls beyond the scope of this document, it is worth pointing out that the two concepts largely overlap, with a difference in focus of the related studies. In SDL, the learners take the initiative of the learning process, self-diagnose their own learning needs, identify human and material resources for learning, choose and implement appropriate learning strategies, and evaluate learning outcomes (Saks, & Leijen, 2014). Studies on SDL focus on the sociological and pedagogical aspects of the learning process. In SRL, the focus of most studies is on the psychological perspective of learning in formal contexts, with emphasis on the cognitive and metacognitive components of the learning process, as well as their interactions with motivation and affect, and behaviours. In SRL research the emphasis is not on the choice of goals: goal setting is understood not so much as the choice of what to learn, but as the identification of personal goals and objectives within the limits of the educational context.

Given their similarities, in the literature, the two terms are often confused although some researchers have attempted to highlight the main differences between the two (Pilling-Cormick & Garrison, 2007, Saks, & Leijen, 2014).

Self-regulated learners, in Life Long Learning, usually avail themselves simultaneously of different contexts in physical or virtual spaces that provide them opportunities for learning. Each context features material resources, relationships, and related interactions and activities. The term learning ecology has been adopted by several researchers (Barron, 2006; Peters & Romero, 2019; Persico, Passarelli, Pozzi, Earp, Dagnino & Manganello, 2019) to identify the ensemble of the contexts the individual draws from in their self-directed life-long learning.

Reflection prompts

Whether you teach in a school, a university or in professional and life-long learning contexts, try to think what aims should be privileged in terms of SRL development in your working context. _____

In your daily teaching practice, do you usually try to make sure your students develop SRL skills, besides achieving their disciplinary learning objectives? If yes, what are your priorities and why? _____



5 SRL: DESIGN PRINCIPLES

Knowing how to manage, regulate and control one's own learning process has always been important, both in formal and informal learning contexts. However, in recent decades, rapid technological change has led to dramatic changes in the way we live, work and learn in our society. As a result, the need to keep learning throughout ones' life is now even stronger in all working and social contexts. This makes SRL skills even more relevant and decisive. Suffice it to say that today many companies, when hiring new staff, prioritize SRL skills in combination with professional ones. The individual's ability to learn new techniques and methods and the flexibility demonstrated in learning to use new methods and tools are crucial. The ability to interact and work with others is also important and, not surprisingly, the concept of SRL should not be regarded as related to individual learning in isolation, but it also involves the social skills needed to learn within a community. Some authors refer to SRL in collaborative context as co-regulation or shared regulation (Hadwin, Järvelä, & Miller, 2017).

Research on SRL tells us that SRL skills generally increase with age but do not develop spontaneously. According to Boekaerts (1997), it is possible to promote their development, i.e. to "teach" them⁷. Other studies support the claim that the development of these skills occurs through practice (Van der Boom et al, 2004). This might seem to be a **vicious circle**: in order to learn them, you need to practice them, but in order to practice them, you need to possess those skills, at least to some extent. This vicious circle can be solved by using the well-known techniques of "*scaffolding and fading*", introduced by Brown, Collins and Duguid at the end of the 1980s (Brown, Collins & Duguid, 1989; Collins, Brown and Holum, 1991), in the context of the *cognitive apprenticeship* theory. These techniques envisage strong initial support from the teacher or tutor, support that then fades away to make room for learner's initiative. In the case of SRL the idea is that teachers should initially provide explicit support to SRL practice, by guiding students in making aware choices as to their own learning, thus later increasing learners' degrees of freedom, in a manner commensurate with their initial abilities and school level.

5.1 What the designer can do

We can therefore begin to think about the ways in which those who design and conduct a training intervention can try to foster the development of self-regulatory learning skills in their students (Dettori & Persico, 2011; Paris & Paris, 2001). In line with what is stated above, the first general recommendation is to **offer opportunities for practice**, which can be translated into "not to decide everything a priori, but to leave margins of freedom to the learner" so that each student can build his own personal learning path. A second general guideline is to **support SRL by scaffolding and fading**, taking into account the learner's initial capacities. For example, if the training intervention will be carried out in a new way, unusual

⁷ It is understood that we are not referring here to teaching what SRL is, but to teaching students how to self-regulate their learning.

for the learner (as it happens for example when an individual enrolls for the first time in an online course), in the first phases of the course it will be necessary to make everyone understand how the training activities will be carried out, with which tools, who are the people appointed to provide help and how to contact them, what is expected of the learner. At first, it may be appropriate to devote some time to getting acquainted with the learning environment⁸, so that participants become familiar with it. A third general recommendation is to **configure and equip the learning environment (be it virtual or real) in such a way as to facilitate SRL practice**, and therefore the development of SRL skills. A classroom layout suitable for passive listening only, or an online environment that leaves learners no room for choice and does not highlight alternatives, is unlikely to support the practice of SRL skills.

5.1.1 Facilitating the forethought phase

To be more specific, let's start by analysing what can be done to **facilitate the forethought phase**. At this stage, actions to support SRL development should:

- activate previous knowledge and meta-cognitive skills;
- offer learners the opportunity to participate in understanding and negotiating the goals, planning the learning process, taking into account one's own preferences and aptitudes, making choices regarding objectives, contents, methods, learning paths, evaluation methods (Ellis & Folley, 2011), organisation of work (configuration of the environment, definition of time, choice of working groups).

For example, stimulating the learners to remember or bring out what they already know about the topic can be useful in helping them to establish their initial 'position' in relation to the content domain addressed and hence define their own personal goals and become aware of their goal orientation. In addition, if the nature of the content allows it, it will be appropriate to allow personalisation of the objectives, the choice of the learning strategies and the types of material (audio, video or text), the choice of themes to practise on, using examples already familiar to the learner.

5.1.2 Facilitating the performance phase

To **support SRL in the performance phase**, on the other hand, it is necessary to offer opportunities to monitor progress in the learning pathway, to control and manage time, to constantly check results, to improve performance by getting help or constructive feedback when needed. The control of the learning environment is also crucial. In the case of a physical environment, the learning designer will need to provide a suitable environment for the learners to choose among and alternate different modes of work: for example, an undisturbed place for individual study or a conveniently configured environment for collaborative work. Ideally, each individual should be able to configure their own environment. In the case of virtual environments, as we shall see in the next chapter, this is easier to achieve than in physical environments.

⁸ The learning environment, here, comprises not only the tools and resources available to learners, but also the people who can be of help, like teachers, tutors and peers.

5.1.3 Facilitating the self-reflection phase

This phase requires opportunities for students to evaluate their own learning process, and to become aware of their own emotional reactions to failure and success.

With regard to assessment methods, Ellis & Folley (2011) propose to leave students a wide margin of choice (in terms of format, i.e. the type of paper to be produced; content, i.e. the subject of the assessment; timing, i.e. deadlines set by the learner). Somewhat provocatively, the two authors go so far as to argue that even the criteria and results of the assessment should be, if not decided, at least negotiated between teacher and student⁹. Of course, this is especially true if we are talking about formative, and not summative, assessment¹⁰. It should not be surprising that, in the literature on SRL (Nicol, & Macfarlane-Dick, 2006), the formative role of assessment and feedback is of paramount importance, as it empowers students to take decisions on how to improve their learning by giving them all possible information to better calibrate subsequent forethought choices. To highlight this role, in recent literature, the expression **assessment for learning** has replaced formative assessment, as opposed to **assessment of learning**, i.e. summative assessment (Wiliam, 2011).

Assessment for learning is therefore the type of assessment that better stimulates self-regulation, because it is aimed at providing students with guidance on how to improve their own performance, identifying weaknesses in their learning and reflecting on how to overcome them. Opportunities for self-assessment and monitoring of one's own performance can also be provided through activities that allow participants to compare the result of their own work with desired outcomes. One way to do this is to facilitate students in comparing their own performance with that of their peers. For this purpose, for example, peer-review practices are regarded as very useful, not only because of the feedback that each participant receives from peers, but also, and mostly, because in doing the peer-review each participant can see how others have tackled and solved a given problem, and can take inspiration to improve their own work (Nicol, Thomson, & Breslin, 2014). Comparison with peers, rather than with experts, as well as being a more sustainable assessment approach for trainers (especially with large numbers of participants), has the advantage of less frequently causing discouragement or negative self-reactions. In the self-reflection phase, the designer will have to ensure a correct attribution of the causes of failure (or success), which is of paramount importance to inform the following forethought phase of the cycle.

⁹ The article by Ellis and Folley (2011) is quite thought provoking because it suggests some guidelines for assessment with a view to self-regulation of learning that are highly innovative and almost provocative in that they destabilise the approaches most frequently adopted in assessment practice by suggesting giving the learner a say in assessment criteria and outcomes.

¹⁰ By formative assessment, we mean here an assessment aimed at providing information that enable the learners to improve their learning, identifying strengths and weaknesses in their performance to leverage the former and work on the latter. This type of assessment is particularly useful if carried out in itinere. In contrast, summative assessment is generally carried out at the end of a learning process, since the aim is to make an overall judgement (e.g. a grade) on the results achieved. In recent literature, the term formative assessment is often replaced by the expression "assessment for learning" and summative assessment by "assessment of learning".

In this discussion we have tried to follow a pattern isomorphic to the phase structure of Zimmerman's model of self-regulation. However, it is important to bear in mind that very often the methods and tools that can be used in one phase can be the same as those that support the others. Take for example the control of timing. In the *forethought* phase, learners preliminarily decide how much time to devote to a certain activity, taking into account their own time availability and their estimate of the time needed (the course designer may offer an average estimate of the time needed for each activity to support the planning). In the performance phase, self-regulated learners keep track of the time spent on the activity and check if the planned time is respected. In the *self-reflection* phase, any significant deviation from the planned time will lead to a re-planning of the time. The tools made available to the learner will presumably be the same for all three phases (e.g. a watch or calendar and a written course syllabus in physical environments, or similar technological tools in virtual environments), but the ways and purposes they will be used will be different according to the phases.

Reflection prompt

Based on the above considerations, which of the learning design principles for SRL skills development do you adopt in your teaching? And which are not part of your usual practice, but might be worth trying? _____

6 SRL AND TECHNOLOGIES

In this section, the complex relationship between technologies and SRL is addressed. In particular, on the basis of the literature in the field, some proposals are formulated on how to put into practice the design principles illustrated in the previous section in the design of TELEs.

SRL has been studied for several decades by numerous researchers, especially educational psychologists, mainly from a theoretical point of view (Boekaerts, Pintrich, & Zeidner, 2000; Shunk & Zimmerman, 1998; Zimmerman & Shunk, 2001; Panadero, 2017). This construct, as we have seen, involves concepts from educational psychology and learning science. In recent years, the diffusion of information and communication technologies has profoundly modified individuals' learning modes and strategies, and TELEs have proved to play an ambivalent role with respect to learners' SRL skills: on one hand, they challenge them (think of the difficulties of orientation in the sea of information made available on the web, to the point of causing cognitive overload and disorientation or even disinformation), and sometimes, on the contrary, they offer tools and functionalities that enable and even stimulate SRL practice. Studies on the relationship between SRL and technologies have therefore flourished, aimed at understanding the potential of technologies for SRL and the conditions that allow this potential to be fully exploited (Bartolomé, Bergamin, Persico, Steffens, & Underwood, 2011; Carneiro, Lefrere, Steffens, & Underwood, 2012; Persico & Steffens, 2017; Dettori & Persico, 2011).

Of course, since there are different types of TELEs, there is no way to make a general statement that applies to all of them. On the contrary, many studies focus on different types of TELE and analyse their potential and requirements in terms of SRL. For example, Azevedo (2005) studied the use of hypermedia systems as metacognitive tools; Littlejohn and colleagues investigated the potential of the role of SRL in MOOCs (Littlejohn, Hood, Milligan, & Mustain, 2016); while Hadwin, Järvelä, and Miller (2017) did the same with Computer Supported Collaborative Learning contexts.

There are also more general studies, such as the TELEPEERS project (Steffens, 2006), which developed a general checklist to assess a priori the potential for SRL capacity building of a TELE and a questionnaire to assess its impact after use. Of course, different learning environments can be configured and used in very different ways. It is therefore important to be aware that even an environment that offers the best SRL affordances can be used (by teachers and/or learners) to no avail.

Among the features that may be regarded as powerful affordances for SRL practice in TELEs, it is important to mention personalization features. Dabbagh and Kitsantas (2004) observe that technologies, and in particular the "student centred" personalized learning environments they enable to create, can induce a radical change, which consists in putting the reins of learning in the hands of the learner, whereas in face-to-face training control remains, to a large extent, in the hands of the teachers. Thus, these environments recreate, in a natural way, that virtuous (or perhaps vicious?) circle between practice and development of SRL skills already discussed at the beginning of the previous section (Fig.2). While Dabbagh and Kitsantas refer to these environments as Personal Learning Environments, other authors prefer to adopt the term learning ecologies (Peters & Romero,

2019). However, personalized learning¹¹ (meaning the process through which learners make personal choices as to how to go about in their learning) is certainly at the core of SRL.

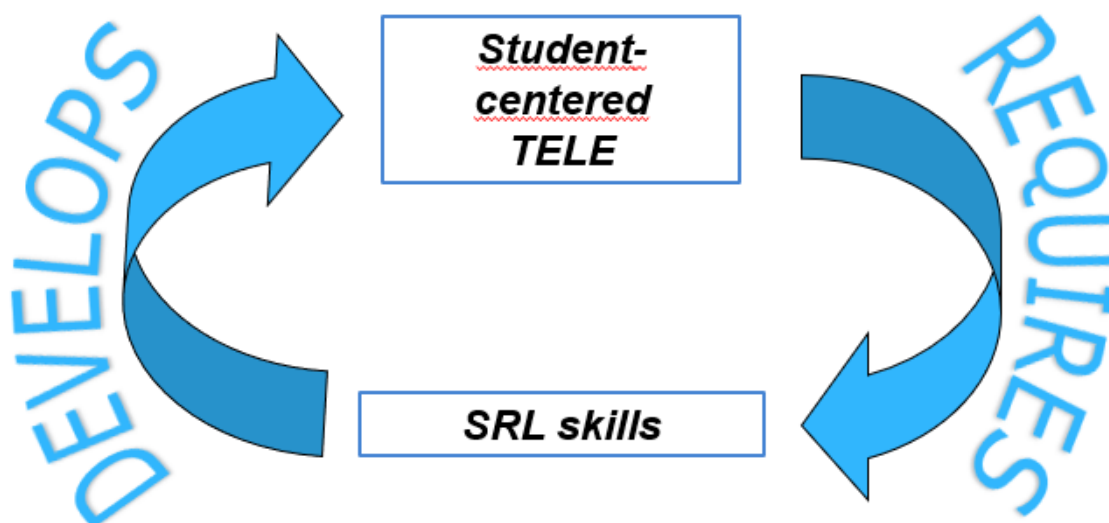


Figure 2: The vicious/virtuous circle of the development of SRL skills

On one hand, TELEs are virtual or hybrid environments offering learners the opportunity to practise SRL skills and thus foster their development, leaving them responsible for deciding whether and how to take advantage of the affordances they offer. In other words, the learner controls the timing, the modes, the interlocutors, the pace, etc. Especially if the learning environment is not closed and rigid, but it is open and flexible, the students are free to build, equip and configure their own technology enhanced learning ecosystem. Consequently, there is no shortage of opportunities to practice SRL and, as we have seen, it is with practice that SRL skills develop. However, if the learners are not yet able to self-regulate, then the situation might get worse in an unfamiliar environment where learners do not feel in control. Therefore, practices related to self-regulation (goal setting, self-monitoring, self-evaluation, task strategy selection, help-seeking, time planning and time-management) in online environments should be facilitated. A typical way is to offer help and tools that 'show the way' or provide useful affordances. Calendars to plan study sessions and be reminded of deadlines, discussion forums to seek help when needed, upload areas to take a look at peers artefacts and draw inspiration and ideas on ones' own, badges and other rewards to keep track of personal achievements (Cucchiara, S., Giglio, A., Persico, D., Raffaghelli, 2014). Otherwise there is a risk that the learner with poor SRL skills will get "shipwrecked" and lost in a sea of content and tools. As we have seen in the section on learning design, it will be necessary to keep in mind the initial capabilities of the students before deciding what kind of environment we are going to provide them.

¹¹ Personalized learning is a term which is often compounded with individualized learning. However, here, we refer to personalized learning to underline that the reins of the learning are in the learners' hands, while in individualized learning it is the teaching agent (be it human or technological) that guides and controls most of the choices, even if it does so to meet individual learners' needs.

Learning to self-regulate one's learning is a bit like learning to swim: for those who cannot even float, diving into the middle of the sea is not a good method: it is too traumatic. The environment must be made easier, with shallow water, boards, floating objects to lean on. For those who already know how to swim but need to improve, there is nothing better than swimming, first short distances in the pool, and then long distances, also facing the deep sea and its waves. The main difficulty is to find the right amount of scaffolding each time: neither too much nor too little, depending on the ability of the learner.

But let us now look again at the three phases of Zimmerman's (1998) SRL model to understand how the design principles outlined in general in the previous section can be applied in TELEs.

6.1 From design principles to tools and strategies that can be used

Table 1 shows, in the left column, the design principles for SRL development discussed in the previous section and, in right column, examples of tools and strategies that have been proposed in the literature for this purpose.

Design principles	Tools and strategies that can be used
<p>Provide an environment in which the learners can easily orient themselves and take control.</p>	<p>Ice-breaking activities can facilitate orientation in the learning environment.</p> <p>Technological tools should have a clear and easy to use interface, navigation facilities are also helpful.</p>
<p>Let the students make choices related to planning and monitoring their learning in terms of:</p> <ul style="list-style-type: none"> • objectives: define personal objectives within the limits defined by the learning aims; • content: offering customisable levels of depth and difficulty, coherent with the personal learning objectives; • methods/media, e.g. allowing the choice between individual and collaborative learning; allowing the use of materials in different formats (audio, video, text, etc.) or languages; • learning strategies, e.g. providing different strategies to meet the different needs and preferences of the students, including the possibility to let individual students to change strategy in case of failure; • timing, e.g. letting students choose when and how long to devote their time to learning activities. 	<p>Interactive tools can be used to facilitate goal setting and planning (e.g. interactive content maps and calendars to visualise the structure of the environment and/or the current status of the learning process, pending tasks, and monitor achievements).</p> <p>Time-monitoring tools with appropriate time-tracking functions and deadline reporting mechanisms can support time management.</p> <p>Learning Analytics tools and dashboards for self-monitoring allow learners to keep track of their learning and to compare their own performance with that of other participants.</p>

<p>Flexibility in the organisation of the study and the working environment is important: the timing should be flexible, the interface of the environment configurable, in collaborative activities team members should be chosen by the learners, whenever possible.</p>	<p>Technological and physical environments should be easy to (re-)configure and students should be made aware of these possibilities.</p> <p>Functions that allow learners to easily skip sections or modules or choose between alternative paths should be available. Such functions should clarify the content of each module and possibly offer self-assessment tools, so that learners are aware of their choices. Hypermedia usually offer the possibility to select different paths within content, but orientation tools are not always provided.</p>
<p>Foster metacognition whenever possible, fostering challenging choices (in terms of learning) rather than self-defensive ones.</p>	<p>Appropriate spaces for meta-reflection should be made available (for example learning diaries, digital or not; alternatively, in CSCL, dedicated areas can be devoted to meta-reflection).</p>
<p>Foster motivation and encourage positive self-efficacy beliefs</p>	<p>The interactions between students and teachers and those among students in collaborative learning are an important source of motivation and feedback reinforcing self-efficacy. Teachers know that feedback should always focus on both positive and suggestions for improvement, not just on critical aspects. However, other strategies can be used: for example, game-based learning and gamification can foster extrinsic motivation. When game mechanics are well aligned with content and learning aims, they can even foster intrinsic motivation.</p>
<p>As far as feedback and self-evaluation is concerned, there should be a choice between different modes of obtaining feedback and self-assess. Students should be encouraged to be proactive in help seeking.</p>	<p>Help-seeking tools or discussion areas allow for timely help seeking. Online tutors and peers play an important role both in responding to students' needs and in helping them to deal with the emotional aspects of learning (such as moments of discouragement in the face of obstacles or failures).</p>

<p>If the learning activity includes the production of an artefact, students should have a choice of topics and types of artifacts, as well as suitable tools to produce them. Assessment should concern both the process and the product and assessment rubrics should be negotiated with students. In any case it is important to ensure that constructive and diagnostic feedback is provided and that negative assessment does not discourage students too much.</p>	<p>Peer review is a useful and sustainable strategy for self-evaluation, because confrontation with peers stimulates self-assessment.</p> <p>E-portfolio tools allow students to get feedback from experts and other students and to choose the artefacts they want to be assessed on.</p> <p>Digital Badges are considered capable of maintaining high extrinsic motivation and self-satisfaction.</p> <p>The use of assessment rubrics (making assessment criteria explicit and negotiable) is highly recommended. Additionally, the degree of self-regulation demonstrated during the process may be included in the assessment rubric. So, if students make choices that optimize learning rather than minimize effort, this effort should be rewarded through assessment.</p>
<p>Emotional support throughout the whole learning process should be provided, either by peers or by tutors, with that special care in avoiding negative emotional reactions.</p>	<p>Collaborative learning environments and tools ensure contacts with peers and tutors, through which emotional support can be provided. Social networks are also often used by learners to seek encouragement even outside the learning community they belong to.</p>

Table 1: Design principles and tools/strategies that can be used to support the SRL

6.2 Self-regulation of learning and Virtual Learning Communities

Virtual learning communities are environments inspired by socio-constructivist theories, in which learning takes place thanks to online collaboration between peers, aimed at carrying out joint enterprises, such as the realisation of a common artefact. In this type of contexts, communication and negotiation of meanings are the main drivers of the learning process. Studies concerning SRL in Computer Supported Collaborative Learning (CSCL) claim that online collaborative learning requires specific SRL skills, resulting from the need to negotiate with community members not only the contents to be learned, but also most of the choices pertaining to the learning process (Dettori, Giannetti & Persico, 2006; Hadwin, Järvelä, & Miller, 2017).

In fact, on the one hand, practicing self-regulation in CSCL may be easier than in other kinds of learning environments because, for example, virtual communities inherently require their members to take an active stance towards the learning process, entail help-seeking as an integral part of socio-constructivist learning dynamics and rely on written interactions, whose permanent nature favours reflection and make it easier to keep track of the learning

process. On the other hand, however, the need to mediate between individual autonomy and the needs of the group introduce an element of complexity. In online collaborative learning choices concerning the learning process need to be negotiated with the other members of the community. Thus, the three phases of the Zimmerman cycle are carried out together with peers, so that objectives, timing, learning strategies, media and any other decision on how to proceed should be agreed upon by the community members (Delfino & Persico, 2007). Even the emotional component of SRL concerns not only the emotions of the individual, but also those of the group, and those of the individual are likely influenced by the emotions expressed by the group. Therefore, self-regulation in these kinds of learning contexts is still necessary but requires different skills, especially at social level.

Some studies on self-regulation in CSCL (Dettori & Persico, 2007; Delfino, Dettori, Persico, 2008) were based on Zimmerman's model, but required adjusting it to consider not only its three phases (forethought, performance and self-reflection) and components (the cognitive/metacognitive, emotional/motivational and behavioural), but also an additional dimension, the individual vs social dimension, which is extremely important in virtual communities. Thus, a three-dimensional table of indicators made it possible to analyse the messages exchanged within the community members (i.e. the persistent traces of the interactions in the virtual environment) in order to study the individual and social dynamics of self-regulation and their evolution over time.

These studies highlighted the importance of the social component of self-regulation in virtual learning communities and led to understand that, in virtual communities, there is a need to balance the self-regulated choices of the individual with those of the other members of the community, which leads to adopt self-regulatory strategies specific to these contexts. In a sense, it is no longer the individual who regulates himself, but the community, making negotiated choices on deadlines, working methods, objectives and content. Consequently, designing paths or environments for online collaborative learning will require taking into account these peculiar dynamics, the time they require and the fact that also the development of these competences has to be supported through scaffolding and fading techniques. In particular, if the participants are new to this mode of learning, it will be necessary to facilitate communication and support collaboration with appropriate techniques (Pozzi & Persico, 2011), create spaces for socialisation and meta-reflection; and take care of the emotional aspects involved, without underestimating them.

This three-dimensional structure underlying SRL dynamics in online collaborative learning is not just a theoretical finding. Rather, it is a useful guideline for designing and evaluating SRL in virtual learning communities. In fact, teachers and designers can use it to check that the CSCL environment they provide to their students offer virtual spaces where all the required interactions can take place and tutors should make sure they foster them.

6.3 Self-regulation of learning and social media

The discussion of how SRL takes place, so far, has focused on how to design online collaborative learning, assuming that learning will take place predominantly within the environment set up to this purpose. However, learning does not take place "in vitro", and not even solely in the learning environment designed by the teacher. Increasingly, learners create their own learning ecologies, by "extending" their learning environment and opening it up to social and technological worlds that go beyond the classroom. These students' personal learning environments may comprise their favourite games, their friends and family

members, the communities they can reach through social media and any other Internet application that allows them to communicate, collaborate, share and create digital contents in the form of textual resources, images, audio and video. The number of users who 'populate' these applications is increasing and the use of these applications for learning often intertwines with use for purposes other than study and learning. Hence, the borders between learners informal and formal learning paths tend to blur.

Social media are not specifically designed for learning, but offer opportunities for learning that frequently intertwine with formal learning (Selwyn, 2012; Ranieri & Manca, 2013). Examples of these applications are *blogging* (e.g. WordPress) and *micro-blogging* (e.g. Twitter) tools, wikis, media sharing (e.g. YouTube), Social Networking Sites (e.g. Facebook) and cloud-based office tools (e.g. Google Apps). Although these tools are not fully fledged learning environments, they contribute greatly to broadening the learning environment of their users, making it more personal.

6.4 Self-regulated learning and Personal Learning Environment

Some of the typical processes of self-regulation (e.g. *help-seeking*) frequently encroach on the technological ecosystem constituted by the social media the individual uses. Since these ecosystems differ from individual to individual, they are often identified with the term **Personal Learning Environments (PLEs)** although more recently some reserachers have introduced the term **Learning Ecologies** (Maina, M. F., & González,, 2016; Peters & Romero, 2019).

The EDUCAUSE Learning Initiative (2009) defines PLEs as "the tools, communities, and services that constitute the individual educational platforms that learners use to direct their own learning and pursue educational goals. PLEs represent a shift away from the model in which students consume information through independent channels such as the library, a textbook, or an LMS, moving instead to a model where students draw connections from a growing matrix of resources that they select and organize. The use of PLEs may herald a greater emphasis on the role that metacognition plays in learning, enabling students to actively consider and reflect upon the specific tools and resources that lead to a deeper engagement with content to facilitate their learning. "

From this definition, it is understandable why PLEs are considered to be the main 'technology enhanced' environment in which self-regulated learning takes place, much more so than the frequently used, and often under-used, Learning Management Systems in our universities. However, as Dabbagh and Kitsantas (2012) note, our students do not always take full advantage of these possibilities, and their teachers are often afraid that their inappropriate use at school may prevent teachers to fully appreciate students' actual knowledge and skills. Dabbagh and Kitsantas investigated the role of PLEs in individual learning and proposed a framework for the use of social media in PLEs to support self-regulation of learning at university level. They argue that academics should explicitly encourage students to use these tools in order to manage their information, to interact and collaborate with their peers and to process, aggregate and manage collective resources. This is all well, but someone needs to get students used to do so, not from the technological point of view, but from the conceptual one. And this is a result that can only be built gradually, and takes time.

The case of professional development in *knowledge-intensive* sectors has, instead, been studied by some Milligan, Littlejohn and Margaryan (2014). These authors proposed a

framework based on 4Cs (*Consume, Create, Connect and Contribute*) representing the ways in which self-regulation occurs in informal learning contexts and, in particular, in the development of professional skills for *Life Long Learning*.

Reflection prompts

Think about some of the TELEs you used with your students: in your opinion, which of their features favour SRL skills development, and which may hinder it? _____



7 CONCLUDING REMARKS

In conclusion, in order to foster the development of SRL competences, it is necessary to: explicitly encourage their use, especially at the beginning, until students use them spontaneously; equip the learning environment with tools that facilitate choices and taking control, such as content maps, time management tools, planning tools, self-assessment tools, etc.

For teachers, the critical aspects concern:

- finding the right balance between teacher control and student control at each different level of students' education;
- providing opportunities for choice, and fostering students to make “wise” choices, that are the ones that maximize learning, rather than those that minimize effort. This principle requires additional effort by the teacher, because offering these opportunities may entail producing different types of material and designing alternative learning paths for the same objectives. Hence, designing for SRL is more challenging than designing a one-size-fits-all course;
- encouraging students to build and rely on their own personal learning environments, so that they get more and more autonomous in the cognitive and metacognitive tasks, and increasingly able to seek help when needed;
- privilege formative assessment over summative assessment, and let the students have a say in choosing how and when assessment takes place. In contexts where summative assessment is also required, the balance must be struck between the need for personalized assessment and the need to ensure uniformity in assessment criteria.

Technologies, especially socio-constructivist and learner-centred learning environments, can greatly help to address these critical issues. However, they can be a hindrance, when they prevent the learners from focusing attention, or provide answers to problems that are better addressed through discovery learning, and most importantly, when students use them for purposes that are other than maximising learning, such as saving time or effort. This is one of the major challenges teachers face with technology: making sure that students become aware of how to use technology not only to learn, but also to manage and control their own learning. The effort, however, is worthwhile, because it pays back in the long term.



Reflection prompts

Think about the design recommendations and the tools that, according to this document, can be used to foster your students' SRL skills. Which are feasible in your own context, and which are not? Why? _____



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