
Karen Triquet, Jelten Peeters and Koen Lombaerts, Vrije Universiteit Brussel

© October 2017 Vrije Universiteit Brussel

No part of this report may be reproduced in any form, by mimeograph, film or any other means, without permission in writing from the publisher.

If parts of this report are referenced or included in deliverables and/or other forms of work/mediums, the following citation must be employed in acknowledgement of the source:

CITATION:

Contents

ABSTRACT ................................................................................................................................. 1

1. INTRODUCTION .................................................................................................................... 2

2 THE SELF-REGULATED LEARNING EVIDENCE BASE ............................................................ 3

   2.1 SELF-REGULATED LEARNING: WHAT FOR AND WHY? .................................................. 3
   2.2 TEACHERS AS SELF-REGULATED LEARNERS ............................................................... 4
   2.3 TEACHERS AS SELF-REGULATING ROLE MODELS AND PROMOTERS ....................... 5
   2.4 ADOPTION AND PROMOTION: MULTI-DIMENSIONAL DETERMINANTS ..................... 5
       2.4.1 Factors internal to the learner/teacher: ...................................................................... 6

3 PART 1: SELF-REGULATED LEARNING MODELS .................................................................. 8

   3.1 ZIMMERMAN’S PROCESS ORIENTED MODEL OF SRL: ..................................................... 8
   3.2 PINTRICH’S COMPONENT-ORIENTED MODEL OF SRL: ................................................... 9
   3.3 SRL CONSENSUS: PHASES, COMPONENTS, AND PROCESSES ..................................... 10

4 PART 2: PROMOTING SELF-REGULATED LEARNING ............................................................. 13

   4.1 FORMS OF PROMOTION ..................................................................................................... 13
   4.2 DIGITAL AFFORDANCES FOR SELF-REGULATED LEARNING PROMOTION .................. 14
   4.3 TECHNOLOGY-ENHANCED AND -ENABLED INNOVATIONS ........................................... 15
       4.3.1 Promoting Self-Regulated Learning in MOOCs .......................................................... 16
       4.3.2 Designing for Self-Regulated Learning Promotion Online ......................................... 18

5 PART 3: EVALUATING SELF-REGULATED LEARNING ............................................................ 20

   5.1 EVOLUTION OF MEASUREMENTS ....................................................................................... 20
   5.2 SCALES AND MEASUREMENTS .......................................................................................... 21
   5.3 MEASURING LEARNER-DETERMINANTS OF SRL ........................................................... 21
       5.3.1 Measuring impacting SRL determinants: Online Environment and Tools ................... 24
       5.3.2 Navigating Challenges in Measuring SRL ................................................................. 25

6 CONCLUSION .......................................................................................................................... 27

7 REFERENCES .......................................................................................................................... 28
ABSTRACT

Teach-UP is a policy experimentation running from 2017 to 2020 involving partners in ten countries. The project focuses on building teachers’ competences for today’s schools, bringing closer together Initial Teacher Education (ITE) and Continuing Professional Development (CPD), and exploring innovative training methods, in particular online courses. During the project questions related to self-regulated learning, tutoring models, peer assessment and conditions for certification are being investigated.

National public authorities (i.e. ministries of education and national agencies) partnering in Teach-UP agreed to focus the online courses to be offered specifically on teacher collaboration, personalized learning, formative assessment and creativity. The focus in WP1 was therefore specifically to identify the gaps in ITE and CPD provision in these four priority areas by means of a consultative survey, a literature review, complemented by a background paper on Self-Regulated Learning. The survey and the literature review are available in a separate document.

The Self-Regulated Learning Online report aims to cover several important dimensions in defining, promoting, and evaluating self-regulated learning, and more specifically self-regulated learning (SLR) online.

The report highlights the necessity and benefits of SLR given the online learning demands and professional development of teachers. It further proceeds to provide a shared understanding by which diverse stakeholders can define SRL, informed and derived from well-established models and the consensus rooted in a scientific evidence base. Parts two and three in turn provide a comprehensive overview of the literature and existing current and emerging approaches and tools, with the aims of allowing for the design (promotion and evaluation) of impactful SRL interventions online.

Ultimately, these aforementioned practices and possibilities, rooted in the state of the art, aim to provide impetus for informed SRL discussion whilst targeting Teach-UP’s proposal aims.
1. INTRODUCTION

This report first and foremost aims to provide an evidence-based overview and understanding of self-regulated learning (SRL), and more specifically regarding its added value and necessity, its promotion, and its evaluation in and through online learning environments.

The document therefore addresses the following dimensions in a condensed and comprehensive manner by: briefly touching upon the evidence-base demonstrating the positive impact of SRL on learning and teaching, providing a shared vision and definition of SRL amidst existing established theoretical frameworks, and the consensus therein regarding phases and areas involved in learners’ self-regulation, highlighting effective and emerging methods to support learners’ SRL development within online learning environments, and ultimately presenting existing techniques to evaluate SRL development online, and the risks, and challenges that lie therein.

The report is targeted at course designers, policy makers, and practitioners alike that are interested in understanding the role and benefits of promoting SRL, and the associated possibilities for design and evaluation thereof in online professional development. Furthermore, the report takes note and addresses some of the key driving objectives of the Erasmus+ call demands (innovative character and scalability), in respects to SRL promotion, whilst situating it firmly within the multi-dimensional Teach-UP objectives and project context. As such the following SRL-referred key changes and questions are kept in consideration in order to enhance relevance and alignment of suggestions:

Key Change 2: “More generalised appreciation and adoption of self-regulated learning in teacher education” and “How can instructional design increase online course and MOOC retention rates?”

In summation, the report aims to create a shared understanding with regards to the roles SRL can and cannot play within online (initial and continuous) teacher professional development, highlight supporting possibilities thereof, and evaluation methods within a scalable, and innovative, online delivery context.
THE SELF-REGULATED LEARNING EVIDENCE BASE

This introduction aims to briefly highlight the necessity and importance of developing self-regulated learning (SRL), whilst situating it within the discourse of emerging and online learning affordances, and teachers’ professional development needs. Additionally, it underlines the potentially favourable implications that developing teachers’ SRL awareness and own practices may have for their students. Lastly, a point of caution is made as to the multi-dimensional and multi-determinant aspects worth considering in promoting SRL online, both at learner-level and system-level in promoting and adopting SRL practices respectively.

2.1 SELF-REGULATED LEARNING: WHAT FOR AND WHY?

The current ubiquity and growing adoption of student-centred learning environments brings to light a number of opportunities and entailed challenges for the modern-day learner (Lang, Siemens, Wise, & Gasevic, 2017). Faced with a growing number of opportunities for online development, as can be seen in the increase of available online courses (MOOCs, NOOCs, SPOCs), and more generally access to information (Littlejohn, Allison, Milligan, & Colin, 2015). Abundant in their provision, these occasionally self-paced, open-ended, and non-linear learning environments call upon the application of several self-regulatory processes, such as: recognising gaps in one’s knowledge, making choices as to one’s learning needs, effective time-management in how and when to learn, planning, reflective practices, and sustained motivation to complete the task successfully (Rowe & Rafferty 2013).

Unfortunately, it is well documented that in gaining this autonomy, and the added responsibility towards taking charge of one’s learning, many learners lack or fail to implement fundamental strategies (Rowe & Rafferty 2013). These strategies are ones that would for example allow them to discern and make use of these respective environments appropriately, as well as the affordances of selected and self-driven educational tools to be able to monitor and modulate their needs, and ultimately successfully fulfil their learning objectives (Lynch & Dembo, 2004; Clarebout & Elen, 2004; Mcmahon & Oliver, 2001). This overarching process of managing and mastering one’s learning within tasks, is what can be broadly understood as SRL (Zimmerman & Schunck, 2001).

Self-regulated learning therefore emphasises the agentic and mouldable role of learners in defining objectives and strategies, dynamically addressing the ongoing planning and undertaking of tasks, and recognising and reflecting on one’s perceptions and its influences alongside the learning task. As noted by Zimmerman (2002) SRL therefore goes beyond relying on skill specific in-depth knowledge, but demands self-motivation, self-awareness, and behavioural skills to effectively leverage that knowledge. This learner-centred adaptive ability to respond to different educational needs, highlights the value of improved SRL abilities in supporting and sustaining lifelong learning and knowledge economy needs of learners (Zimmerman, 2002; Littlejohn, Allison, Milligan, & Colin, 2015; Fontana, Milligan, Littlejohn & Margaryan, 2015).

Self-regulated Learners can be defined as:

“Proactive in their efforts to learn because they are aware of their strengths and limitations and because they are guided by personally set goals and task-related strategies. These learners monitor their behaviour in terms of their goals and self-reflect on their increasing effectiveness. This enhances their self-satisfaction and motivation to continue to improve their methods of..."
Given the context of Teach-UP, it is worth noting that the very nature of learning online, is in itself often associated with greater learner autonomy, and in-turn demands greater learner control, management, and self-motivation towards successfully completing set learning objectives (Laer & Elen, 2016; Tsai, Shen & Fan, 2013; Lynch & Dembo, 2004). Moreover, results of studies on online SRL behaviours demonstrate that for those students that are able to regulate their learning, there are several beneficial effects associated with goal attainment (Kizilcec, Pérez-Sanagustín & Maldonado, 2017; Laer & Elen 2016). Furthermore, effective SRL strategy use is also seen to have positive effects regarding learners’ perceptions of, communication, and collaboration habits within the online course (Lynch & Dembo, 2004).

On the flipside, the existence of online learning environments in themselves present a number of interesting technology affordances and possibilities towards supporting and promoting SRL (Rowe & Rafferty, 2013; Tsai, Shen & Fan, 2013; Littlejohn & Milligan, 2015; Bernacki, Aguilar & Byrnes, 2011; Carneiro, Lefrere & Steffens, 2007). The embedding and integration of multi-level SRL promotional affordances within course designs (Harris, Lindner, & Pina, 2011), and the associated gains for researchers and students alike (Panadero, Klug & Järvelä, 2016), has gained both recognition and consensus in the field towards the potential effectiveness of aiding SRL development (Lang, Siemens, Wise & Gasevic, 2017; Manso, Caeiro & Llamas, 2016).

2.2 Teachers as Self-Regulated Learners

Touched upon more generally, today’s dynamically evolving learning environments present a complex set of demands as well as opportunities on students in general (Mcmahon & Oliver, 2001; Rowe & Refferty; 2013). In the case of Teach-UP, the focal group in question, is both the incoming and existing teaching workforce. Given the constant state of flux, increasing complexity, change, and demands of teaching, as well ongoing need to update one’s knowledge base; teachers as learners themselves must be equipped with effective strategies to reflect upon and adapt their practice. Improving their own SRL is necessary in order to keep abreast with the landscape changes and challenges encountered respectively, as well as the ability to respond to diverse and changing student needs (Carneiro, Lefrere & Steffens, 2007).

There is not only an abundance and range of developmental topics teachers now have to choose from, but equally flexible and mobile approaches, as well as highly collaborative and networked environments to target bespoke learning needs. These often self-driven e-learning developmental pathways, and their associated perceived cost-effectiveness, present interesting avenues for continued professional development (Kamenetz, 2010; Littlejohn, Allison, Milligan, & Colin, 2015; Fontana, Milligan, Littlejohn & Margaryan, 2015). In this sense, it is important to reflect and focus on the teachers in question (pre-service and in-service), and their respective roles, not as teachers, but first and foremost as learners themselves to successfully undertake and complete e-learning courses (Butler et al., 2004; Kramarski & Michalsky, 2009). This brings us to question the associated capacities and strategies that may be beneficial in promoting SRL development across online professional development avenues, and the possibilities for supporting them accordingly with diverse (digital and

### 2.3 Teachers as Self-Regulating Role Models and Promoters

Beyond improving teachers’ own capacity for self-regulation in autonomously and successfully addressing complex professionalization challenges and provision, the value in further sensitizing and developing teachers’ self-regulation awareness, and toolbox of strategies has potential implications for their students SRL (Zumbrunn, Tadlock & Roberts, 2011; Paris & Winograd, 2003; Zimmerman, 2002; Dignath-van Ewijk, Dickhäuser, & Büttner, 2013; Dignath-van Ewijk & van der Werf, 2012). Given the teachable nature of self-regulatory processes, as well as the research demonstrating that SRL “is not a single personal trait that individual students either possess or lack” (Zimmerman 2002, p. 66), highlights the learnable dimension, and consequent key role that teachers’ play in SRL promotion for their students (Lombaerts et al., 2009; Peeters et. al, 2016; Moos & Ringdal 2012; Perry, Hutchinson & Thauberger, 2008).

Empirical studies across diverse age groups, subject areas, and modes of study display beneficial outcomes of teachers’ self-regulated learning interventions and process support (Perry, Hutchinson & Thauberger, 2008). The ability for teachers to support SRL, be it in their classroom practices (Peeters et al., 2015; Lombaerts, Engels & van Braak, 2009), as well as in their design and delivery of SRL supportive e-learning environments (Rowe & Rafferty, 2013; Butler et al., 2004; Littlejohn, Allison, Milligan, & Colin, 2015), has demonstrated significant positive consequences for students’ self-regulatory competencies. Examples of these aforementioned impacts are, but not limited to: increased dedication to learning, improved self-monitoring, and heightened performance awareness (Panadero, Klug & Järvelä, 2016; Schunk & Zimmerman, 1998; Paris & Paris, 2001).

Although these aforementioned positive effects on students’ SRL development have been found whilst teachers’ made adjustments to the learning environment (Butler et al., 2013; Perry & VandeKamp, 2000; Perry, VandeKamp, Mercer, & Nordby, 2002; Perry et al., 2004), and/or modified their teaching practices (Kistner et. al., 2015; Lombaerts, Engels & van Braak, 2009; Michalsky, 2012); more subtle implications of developing teachers own SRL repertoire have equally been noted in the literature. Studies demonstrate that students also learn self-regulation strategies through observation (Zimmerman, 2002; Peeters et al., 2013). This further exemplifies that enhancing teachers own SRL knowledge base, is equally necessary in order to make diverse strategies visible to students. Furthermore, teachers’ SRL repertoires also have implications on teachers capacities to elaborate upon the reasons for, value of, and uses of strategies being modelled to students (Paris & Winograd, 2003).

Therefore, in developing teachers own SRL, and heightening their respective approaches to and understanding of the diverse strategies to manage and succeed in their own learning; it is found to be more likely that they in turn will engage and promote those practices with their students (Finsterwald et al., 2013).

### 2.4 Adoption and Promotion: Multi-dimensional Determinants

Overall, regarding the teachable nature of SRL, be it for teachers own learning, or their respective teaching of SRL skills to their students, the successful adoption and effective practice of self-regulation strategies is prone to individual differences. These differences relate to one’s own adoption abilities,
as well as contextual determinants at teacher and school (and or learning environment) level. Consequently, it is worth noting several multi-level factors that both in the case of learning (teachers as SRL students), and teaching (teachers as promoters and self-regulating models), might impact SRL strategy assimilation (Lombaerts, Engels & van Braak, 2009; Peeters et al., 2016; Littlejohn, Allison, Milligan & Colin, 2015).

2.4.1 Factors internal to the learner/teacher:

Although educational researchers have demonstrated on several counts that high self-regulating students perform better than their lower regulating counterparts academically (Chen, 2002; Pintrich, Wolters & Baxter, 2000); teaching SRL strategies is not necessarily a straightforward instructional feat, nor a linear all-encompassing solution towards improving learner outcomes (Boekaerts, 1999). As highlighted by Zimmerman (1989, p.21) “learning is not something that happens to students; it is something that happens by students.” This intentional effort and active dimension to successfully attaining ones targeted academic objectives, underlines the learners’ role, independent of the teachers’ level of orientation, and the challenge (as well as opportunity), in promoting SRL therein (Kizilic, Perez-Sanagustín & Maldanado, 2017; McMahon & Oliver, 2001). Equally highlighted by Brooks (1997), there is still always an element of choice, impacted by both affective and motivational conditions, in which simply the fact that learners know what must be done, does not in itself assure that they will actually do it.

Moreover, as demonstrated by Kizilic, Perez-Sanagustín and Maldanado (2017), in identifying which strategies predict learner behaviour and goals attainment online, several learner characteristics were equally found to impact SRL. In their study, characteristics such as student demographics and motivation, were predictive of learners’ SRL skills observed within the MOOCs. Additionally, Clarebout and Elen (2004), also highlighted the individual digital competence of learners in online environments as potential barriers towards taking advantage of, and effectively employing the range of learning gains available.

Conversely, in the act of teaching self-regulated learning strategies, individual differences have also been observed. From teaching beliefs in employing transformative teaching approaches (Lombaerts et al., 2009; Errington, 2004), to teachers’ perceptions of their students’ abilities, and resulting instructional responses (Peeters et al., 2016), these are some of the differences that have been found to impact teaching promotion of SRL.

2.4.1.1 Factors external to the learner/teacher:

On a more systemic level, the transference and actual application of those skillsets within a teachers’ and learners’ practice also deserves some attention. Actual SRL promotion has been shown to be influenced by both teacher and school-level (and or learning environment) determinants (McMahon & Oliver, 2001; Panadero, Klug & Järvelä, 2016; Lombaerts, Engels & van Braak 2009). Moreover, a solid evidence base stands to demonstrate the important role of design and instructional approaches, that either enable and or hinder SRL promotion whilst creating and nurturing of a particular learning ecosystem for learners (Littlejohn & Milligan, 2015).

Therefore, having highlighted broadly what a self-regulated learner might entail, and the potential merits of self-regulating within increasingly self-reliant online learning environments, stresses the need for clarity towards what exactly tangible online self-regulated learning (SRLO) processes are. Understanding these processes is necessary in order to further promote them (and therefore enable
learners and teachers), as well as to evaluate their impact as interventions respectively. This raises the following questions, which will in-turn be addressed in the subsequent parts of the report:

How can we define SRL in actual learning processes?

What are ways to promote SRL strategy development online?

How can technologies promote and or support SRL online?

In what ways can SRL development online be evaluated and measured?
PART 1: SELF-REGULATED LEARNING MODELS

The field of SRL research is extensive in nature and scope, and consequently has led to the development of several models and theories attempting to describe and distinguish attributes of successful learners (Bandura, 1986; Boekaerts et al., 2000; Pintrich, 2000; Zimmerman, 1990). Nevertheless, albeit differences exist amongst theorists and models, a general consensus can be found regarding the vision they put forward in describing SRL phases, components and the processes involved.

Although not all of the models will be elaborated upon in this report, detailed and comparative reviews of existing models can be found in Zimmerman and Schunk (2001), Puustinen and Pulkkinen (2001), and Panadero (2017) respectively. For the purposes of highlighting the state of the art and relevance to Teach-UP, two well established models will briefly be elaborated upon in demonstrating the multidimensionality of SRL, followed by an integrative approach and resulting identification of shared understandings regarding SRL phases, components, and learning processes that students employ to accomplish a set task.

3.1 ZIMMERMAN’S PROCESS ORIENTED MODEL OF SRL:

Zimmerman defines self-regulation as “self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals” (2000, p. 14). Zimmerman’s model (see Figure 1), puts forward three distinct phases: (1) the forethought phase, (2) the performance phase, and (3) the self-reflection phase (see Figure 1). Each of these phases in turn reflects specific components: (1) Meta-cognitive, (2) Motivational, and (3) Behavioural (Zimmerman, 1989, 1990, 2002), in which the learner undertakes particular processes in order to self-regulate.

For example, taking a look at what this means within the forethought phase (an initial phase occurring prior to starting the task). Self-regulating students would approach the task by “analysing it, assessing their capacity to perform it with success and establishing goals and plans regarding how to complete it”. Both intrinsic task interest and goal orientation are crucial towards achieving reflective planning and later task performance. Students will “analyse what the task characteristics are by creating a first representation of how it should be performed. Second, they analyse the value the task has for them, this conditions their motivation and effort, and therefore, the attention they will pay during the performance; in other words, their activation of self-regulatory strategies.” (Panadero & Alonso-Tapia, 2014, p. 452).
3.2 PINTRICH’S COMPONENT-ORIENTED MODEL OF SRL:

On the other hand, there are certain differences amongst models, and consequent value behind incorporating an integrative model to observing and defining SRL within technology-enhanced learning environments (Manso, Caeiro & Llamas, 2014). Pintrich’s comprehensive model of self-regulated learning (elaborated below), provides us with, amongst other comprehensive intersecting oversights on SRL, the addition of contextual sensitivity.

In the words of Pintrich (2000), SRL is defined as "an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behaviour, guided and constrained by their goals and the contextual features in the environment". Pintrich’s model (see Table 1) proposes four phases and four components, that in-turn lead to several self-regulation processes. Although a more comprehensive account can be retrieved from Pintrich (2000), self-regulatory processes can be seen to fall into four phases (also termed as stages within the model, but will employ phases for consistency): (1) planning and goal setting, (2) self-monitoring, (3) controlling and (4) reflecting. These phases are then equally overlapped by four components: (1) cognition, (2) motivation, (3) behaviour and (4) context, under which interactions are produced as learners’ progress and employ particular self-regulating processes accordingly to complete a set learning task.

For example, as elaborated by Rowe & Rafferty (2013, p.591):

“The final stage of reflecting includes evaluations that learners make regarding execution of the task. Processes in this stage include comparison of the executed task to previously established criteria that were determined by the learner and/or provided by the instructor, internal and external feedback
about the results of the task, consequences for the results, behaviour to be followed, as well as overall assessments about the task.”

<table>
<thead>
<tr>
<th>Stages</th>
<th>Cognition</th>
<th>Motivation</th>
<th>Behavior</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning and goal setting</td>
<td>Setting target goals</td>
<td>Accepting responsibility for goals</td>
<td>Planning for time, effort, and self-observation</td>
<td>Perceiving the context of the task</td>
</tr>
<tr>
<td></td>
<td>Activating prior knowledge of the domain</td>
<td>Judging confidence for completing the task</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Recognizing the difficulty of the task</td>
<td>Perceiving the difficulty of the task</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identifying knowledge and skills needed for completing the task</td>
<td>Generating interest in the task</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-monitoring</td>
<td>Checking for comprehension</td>
<td>Being aware of motivation and interest</td>
<td>Being aware of effort and need to seek help</td>
<td>Checking for changes in the task and context conditions</td>
</tr>
<tr>
<td>Controlling</td>
<td>Selecting and adapting strategies for making meaning</td>
<td>Selecting and adapting strategies for controlling motivation and interest</td>
<td>Increasing and decreasing effort</td>
<td>Restructuring the task</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Persevering or giving up</td>
<td>Changing or leaving the context</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Seeking help</td>
<td></td>
</tr>
<tr>
<td>Reflecting</td>
<td>Making judgments about understanding</td>
<td>Having reactions</td>
<td>Analyzing feedback</td>
<td>Assessing the task within the context</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Stages and Processes of SRL


### 3.3 SRL Consensus: Phases, Components, and Processes

Potentially visible within the aforementioned models, general agreement amongst the scientific literature and theorists can be found regarding phases and components of self-regulated learning, albeit whilst employing slightly different vocabulary (Bandura, 1991; Pintrich, 2000; Zimmerman & Schunk, 2001; Beishuizen & Steffens, 2011; Manso, Caeiro & Llamas, 2014). The identification and shared agreement amidst these models sheds greater light on the self-regulatory sub-processes that can be understood to impact learning outcomes, and in-turn provides pathways and opportunities for targeted SRL interventions (Fontana, Milligan, Littlejohn & Margaryan, 2015).

Therefore, although slight distinctions exist, when establishing concurrence with the learning episode (Manso, Caeiro & Llamas, 2014), three distinct phases of self-regulated learning (cyclical in nature), can be established as follows:

1. Forethought, Planning and Activation.
2. Performance, Monitoring and Control.

Additionally, whilst employing an integrative model approach to define SRL (Manso, Caeiro & Llamas, 2014), the components of SRL (which in turn overlap across the cyclical pre-during-post phases), allow for the following distinct SRL learning processes to be identified:

**Metacognition.** This component covers setting goals, planning, self-monitoring, organizing, and self-evaluation. These are skills that involve inherent knowledge as well as self-awareness towards monitoring understanding and regulating one’s cognitive processes (Kauffman, 2004; Whipp & Chiarelli, 2004).

**Motivation/Affect.** Agreed to be a key factor towards academic success (Zimmerman & Schunk, 2001), this component covers intrinsic task interest and activation, high self-efficacy (belief and confidence in task success/accomplishment), and self-attributions (determination and attribution of consequent impacts of behaviour).

**Behavioural.** This component covers dimensions that are aimed at strategies favourable to optimizing ones learning such as: help-seeking, self-observation, and time-management to name a few.

**Cognition.** This component covers learning processes such as information strategies (searching, selecting, acquiring and processing content), problem-solving, memorisation etc.

**Context (Social and Environmental).** This component covers task evaluation, monitoring and restructuring, changing one’s context conditions, etc.

These components therefore interact across the phases and result in to distinct self-regulation processes or strategies as often termed, employed by learners. Although several definitions of strategies exist, for the purposes of this report we will consider Manso, Caeiro and Llamas (2014) interpretation as “the methods and procedures that the students can use to help them tackle their learning in the most effective and competent manner, to plan, monitor and evaluate the five SRL areas” (components in our case).

Conclusively, the elaborated models’ respective strengths, combined with the empirical evidence on SRLs generally accepted rationale, provide us with a scientifically informed, shared, and supported understanding by which to approach self-regulated learning. This in turn allows for greater insights into distinct SRL strategies (Zumbrunn, Tadlock & Roberts, 2011), that highly self-regulating learners might employ whilst planning, monitoring and evaluating their learning episodes (Beishuizen & Steffens 2011; Manso, Caeiro & Llamas, 2014); and ultimately enable them to perform better academically within and beyond formal educational boundaries. In stating this, it must be highlighted that although theorists largely agree on components and sub-processes of SRL, the targeted promotion emphasis thereof, and likelihood of impact on learning outcomes differ greatly (Rowe & Rafferty, 2013). These will therefore be addressed selectively in the following section, whilst we consider and elaborate upon findings that are most relevant and important for Teach-UP.
Key Concept.

Self-Regulated Learning:


Learning Processes (and/or strategies):

Sequences of procedures that learners are equipped/or not equipped with which they then select and adapt in order to tackle different learning challenges. Learning strategies reflect the different sub-processes across areas and phases that entail SRL, and can be taught and learned respectively.
4 PART 2: PROMOTING SELF-REGULATED LEARNING

Having defined an integrative model by which to understand the phases, the components, and the associated sub-processes (strategies) that would qualify of a self-regulated learners’ profile, raises in turn the question of how to potentially stimulate these. Researchers therefore, have sought and currently seek to understand high and low SRL student profiles, particularly with the aims of understanding how to assist poorly regulating learners to develop key processes such as, time management, goal setting, self-evaluation, help seeking, and importantly self-motivational beliefs to name a few (Zimmerman & Schunk, 2001).

Given the range and number of promising discoveries to-date into how students learn, and can be assisted to self-regulate their own learning pathways respectively (Zimmerman & Schunk, 2001); in order to further advise upon an SRL promotion intervention, several steps must be covered to allow for a more informed and adapted approach. Therefore, drawing from field-specific literature and evidence-based conclusions on what might be feasible, and ultimately learner beneficial (improving learning gains, and in the case of Teach-UP, also MOOC retention), several aspects of promotion should be addressed.

Firstly, it is important to understand and consider what types of strategy promotion exist to teach self-regulated learning. Secondly, given the online nature of Teach-UP, it is worth taking note of what existing and emerging technology-enhanced learning environments and/or digital tools, either directly or purely given their technological make-up, might lend themselves to supporting and/or transforming self-regulatory strategy promotion for learners, and how one might go about judging that SRL potential to make an informed decision. Thirdly, it is necessary to narrow these, in aiming to gain an informed insight of existing beneficial promotion strategies found within the empirical online and distance learning literature. This process will in turn allow for the selection and creation of a more reliable approach and/or environmental design towards promoting SRL online; employing observed promotional methods and/or strategy-priorities that are most effective in aiding learner success, and importantly maximising the potential of obtaining impactful intervention outcomes.

4.1 FORMS OF PROMOTION

From modelling and providing skill-specific practice possibilities, to prompting learners to perform a particular activity during the learning event, promotion methods range in how they trigger SRL development with the learner (Zimmerman, 2002; Rowe & Rafferty, 2013; McMahon & Oliver, 2001). Kistner et al., (2010), highlight several ways in which to categorise and identify how teachers can facilitate SRL development in their students through direct and indirect instruction.

Direct Instruction:

This type of instruction involves both the explicit and implicit instruction and vocalization respectively of different SRL strategies, from how to carry out the strategies to understanding the contexts and demands for and of their effective use (Zimmerman, 2008; Boekaerts & Corno, 2005; Kistner et al., 2010; Paris & Paris, 2001). Teachers can foster direct instruction of SRL in the following two ways:

Implicitly:
Implicit direct instruction methods that teachers can employ to support SRL include those such as: modelling the strategy for students, prompting the use of strategies, encouraging as well as suggesting strategies during the learning process. (Zumbrunn, Tadlock & Roberts 2011; Lapan, Kardash & Turner, 2002; Paris & Newman, 1990).

Explicitly:

Contrarily, explicit direct instruction includes methods such as verbalization and elaboration upon the necessary conditions for, the significance of, and usefulness of specific strategies for student performance (Kistner et al., 2010; Peeters et al., 2016).

Indirect Instruction.

Indirect facilitation of SRL development that teachers can employ involve ways to manipulate contextual conditions encountered by students during the learning process. These deliberate manipulations of the learning content, tasks, classroom practices and teaching methods to foster students’ SRL skills allow teachers to create powerful SRL promoting environments (Kistner et al., 2010).

Alternatively, in addition to acknowledging the forms of encouragement for SRL mentioned above, Zumbrunn, Tadlock and Roberts (2011), put forward several strategies for students gathered from across the SRL literature base. Although rooted within the context of the formal classroom, the findings are relevant to multiple learning contexts and modes of delivery. Briefly listed, the authors literature findings resulted in the following strategies to promote SRL and facilitate students learning: goal setting, planning, self-motivation, attention control, flexible use of learning strategies, self-monitoring, appropriate help seeking, and self-evaluation. For an in-depth understanding of what these entail, and the associated empirical literature underpinning them, it is advisable to consult the review in question in order to integrate them effectively (p. 9-16).

Ultimately, in highlighting general forms of promotion, and several existing SRL strategies, Mooij (2008, p. 11) sums up the mutually complementing nature of these methods, towards developing and encouraging SRL in students nicely with the following advice:

“self-regulation should benefit from the selection of learning tasks and the coaching and assessment of learning. These three activities may be learner-controlled, but they may also be assisted by teachers or tutors.”

4.2 Digital Affordances for Self-Regulated Learning Promotion

As outlined earlier (see Part 1), strategies in themselves are ‘tools’ that students employ (from their own toolbox and gained knowledge), when putting into action and practice self-regulation towards their learning objectives. These strategies (or tools), are therefore inherent to the individual, flexible and adaptable in use, context-dependent in influence, and teachable as well as learnable in nature (Zimmerman, 2002). This is an important point to highlight, given that this lexicon of strategies forms the basis by which learners self-regulate within and beyond technology-enhanced environments towards reaching their diverse learning objectives.

Conversely, the addition of advanced technology-enhanced supports might in-turn afford learners with greater efficacy and efficiency when aiming to self-regulate online, and whilst applying various learning
self-regulated learning online strategies accordingly (Carneiro, Lefrere & Steffens, 2007; Laer & Elen, 2016; Mooij, 2008). There are diverse digital tools supportive of the learning processes elaborated in Part 1 (defining SRL). These range from tools specifically focused on SRL sub-process supports (and in-turn varying towards the extent of delivery therein), to generic tools that offer several opportunities towards supporting various SRL processes (Manso, Caeiro & Llamas, 2014).

Examples of specific tools might include, but are not limited to: electronic portfolio’s, Learning Management Systems with particular SRL functionalities (Carneiro, Lefrere, Steffens & Underwood, 2011), diverse computer-based tutoring and scaffolding approaches, such as intelligent tutoring systems, for example MetaTutor (Azevedo, Johnson, Chauncey, & Burkett, 2010), and other computer based cognitive tutors (Manso, Caeiro & Llamas, 2014; Azevedo, 2005; Burguillo & Llamas, 2009) and SRL targeted software (Winne & Hadwin, 2013).

Generic Tools on the other hand, not created with the particular intent of promoting SRL, might include collaborative work tools (e.g Google Docs, Office Sharepoint), time management tools (TimeEdition), Project managers (Trello, Asana), smart planners and task managers (ClockingIt), and various curation tools (Carneiro, Lefrere, Steffens & Underwood, 2011; Manso, Caeiro & Llamas, 2014).

4.3 Technology-enhanced and -enabled innovations

From environmental freedom and learning mobility (Panadero, Klug & Järvelä, 2016), to capturing and reflecting back to learners selective SRL progress insights via dashboards (Lang, Siemens, Wise & Gasevic, 2017; Panadero, Klug & Järvelä, 2016), personalization abilities (Carneiro, Lefrere, Steffens & Underwood, 2011), real-time feedback (Mooij, Steffens & Andrade, 2014), web-enabled prompts (Tsai, Shen & Fan, 2013), and 1-to-1 tutoring (Burguillo & Llamas, 2009), these examples are just some of the promising ways in which technology is being employed to support SRL promotion. Given the very nature of Teach-UP and call priority theme: “Strengthening teacher training and education by using the opportunities of new technologies”, several emerging avenues and initiatives of TEL-SRL promotion, research, and opportunities towards innovative and scalable supports and approaches, are worth briefly addressing and are consequently listed below for consideration towards the MOOC design:

Pedagogical Agents: These range from basic guides, recommender systems and assistive agents to smart and artificially intelligent (AI) agents. Several existing interventions and research routes are currently investigating whether, and to what degree these agents (sometimes termed tutors and teaching assistants), might assist student learning and motivation (Heidiga & Clarebout, 2011; Dinçer & Doganay, 2017), academic success and cognitive load (Dinçer & Doganay, 2017), and more general SRL strategy development possibilities (Manso, Caeiro & Llamas, 2014). Some existing examples of AI powered initiatives that have been employed to support students include:

Differ Chat (Kristian Collin Berge, Edtech Foundry).
Jill Watson (Ashok Goel, Georgia Tech).
TQ-Bot (Burguillo & Llamas-Nistal, University of Vigo).
Allice Bot (Artificial Intelligence Foundation).

MetaTutor (Roger Azevedo, North Carolina State University).
Learning Analytics: Applicable in a number of ways to support learning, the recently published first edition ‘Handbook of Learning Analytics’ (Lang, Siemens, Wise & Gasevic, 2017), highlights several instances in which analytics could be employed to further SRL promotion through the use of predictive and explanatory approaches. These range from early drop-out prevention, consequent targeted interventions and retention supportive actions, to providing data-driven student feedback and insights based on defined conditions and/or parameters to name few.

Data Visualisation: Learning dashboards, as interactive visual representations, can provide greater insight as well as understanding into collected traces of learner’s activities (Verbert et al., 2014). They are capable of incorporating several types of data, and therefore might allow for an overview of one’s progress on various components of SRL (Lang, Siemens, Wise, & Gasevic, 2017). Additionally, this visualisation can in turn support SRL by promoting reflection, awareness, team work, and sense-making, depending on the types of dashboards, individual or group, employed (Arnold & Pistilli, 2012; Verbert et al., 2014; Govaerts, Verbert, Duval & Pardo, 2012).

Connectedness: The transformative networked and collaborative dimensions provided through technology-enhanced learning environments can also serve as tools for promoting SRL. These may serve in assisting groups’ joint regulation i.e. socially-shared self-regulation (SSRL) given group interaction and co-regulation possibilities on tasks (Jarvela et al., 2015; Hadwin, Järvelä & Miller, 2011). Additionally, these connected affordances have also been demonstrated to allow for greater relevance, audience, and authenticity for student tasks; in turn potentially allowing for SRL development and promotion possibilities (Carneiro, Lefrere, Steffens & Underwood, 2011; Carneiro, Lefrere & Steffens, 2007).

In summing up, the empirical literature and existing multi-modal research activity, would stand to confirm the SRL-supportive potential offered by existing and emerging digital affordances. It must be noted however that this is often found within a discourse highlighting the associated importance of selection regarding impact of tools (Pandero, Klug, Jarvela, 2016), good judgement as to the supportive-level of tools (Carneiro, Lefrere, Steffens & Underwood, 2011; Manso, Caeiro & Llamas, 2014; Azevedo 2005), and importantly and often overlooked, learners’ capacities and competencies on a technical level to confidently select and/or make use of these digital tools (Clarebout & Elen, 2004; Lynch & Dembo, 2004).

Key Concept:
Technology-enhanced learning environments: “an umbrella term that encompasses all forms of computer and web-based learning environments such as interactive and hypermedia, computer-assisted, distance, virtual, web-enhanced, hybrid, blended, and online.” (Rowe & Refferty, 2013, p. 593)

4.3.1 Promoting Self-Regulated Learning in MOOCs
It is no hidden fact that there has been an exponential increase in computer and web-based technologies at the service of educational change, and more importantly learner support, over the past two decades (Rowe & Rafferty, 2013; Laer & Elen, 2016; Harris, Lindner & Pina, 2011). This increased availability, and the associated and expanding evidence-base of interventions, has generated an abundance of technology-enhanced learning (TEL) approaches, modes of delivery, and existing environments to promote SRL (Garrison & Vaughan, 2008; Lynch & Dembo, 2004). It is important
therefore to further situate TEL-SRL promotional capacities within the Teach-UP context (online professional development for pre-service and in-service teachers), and MOOC delivery.

First and foremost, it is worth noting that many forms of SRL promotion (Laer & Elen, 2016; Rowe & Rafferty, 2013; McMahon & Oliver, 2001), as well as targeted development of self-regulation strategies (Harris, Lindner & Pina, 2011; Lynch & Dembo, 2004; Kizilcec, Perez Sanagustin, & Maldonado, 2017; Kohen & Kramarski, 2012), have been observed in online learning environments. However, although these studies converge in that they address the ensued learner demands of online learning, and the critical need for self-regulatory capacity of students, they don’t provide a clear and coherent solution as well as pedagogical framework that might be scalable beyond the situational particularities of the study in question (Laer & Elen, 2016; Kizilcec, Pérez-Sangustín, & Maldonado, 2017). This resulting ambiguity on the scalable impact of intervention efforts and effectiveness of strategies, as well as the range of outcomes across settings (also in part derived by the multi-dimensional and contextual nature of SRL), can make it challenging to locate, select, manifest, and ultimately assure the success of SRL intervention efforts offline and online.

Several research initiatives do however provide helpful insights as to what educators and course designers should know. These look at existing interventions, and how educators might therefore design and apply SRL interventions, with the aim of improving pupils’ learning experiences and academic outcomes (Rowe & Rafferty, 2013; Harris, Lindner & Pina, 2011, Kizilcec, Pérez-Sangustín & Maldonado, 2017). These studies will therefore be elaborated upon with the intention of 1) highlighting promising and existing efforts to promote SRL online, and 2) allow for greater understanding regarding the outcome of such efforts on pupils SRL and/or learning effects.

Firstly, Laer & Elen (2016), examined the blended learning evidence base from 1985 to 2015. Within their extensive study, they identified and defined several attributes that support students’ self-regulatory abilities. In total, seven core attributes to support SRL were found across the literature: personalization, interaction, authenticity, scaffolding, learner-control, cues for reflection and for calibration.

Lynch and Dembo (2004), also reviewed the existing self-regulation evidence base across the literature on distance education. The aim of the research being “to identify learner self-regulation skills predictive of academic success in a blended education context” (p.1). The study resulted in the formulation of five different regulation attributes judged to be predictive of students’ academic performance. The following factors were identified: intrinsic goal orientation, time and study environment management, self-efficacy for learning and performance, help seeking, and internet self-efficacy.

Taking a slightly different approach, but with a complimentary objective of finding the most effective SRL promoting strategies and relation to academic performance, Kizilcec, Pérez-Sangustín and Maldonado (2017), conducted research on a sample of 4,831 students across 6 different MOOCs in higher education. By employing student records, course achievement, survey responses, and online measures of course content interactions, several strategies were found to impact learning. The findings highlighted that “goal setting and strategic planning predicted attainment of personal course goals, while help seeking was associated with lower goal attainment. Learners with stronger SRL skills were more likely to revisit previously studied course materials, especially course assessments” (p.18). Overall, the following strategies (listed below by the authors), were identified as expected to assist learners in achieving within MOOC environments (pg. 21).
These studies provide important insights into the nature and landscape of online SRL promotion, SRL profiles and attainment. It is advisable in planning the Teach-UP intervention, to further consult the aforementioned articles for a more detailed construct breakdown of what those identified factors entailed in practice.

4.3.2 Designing for Self-Regulated Learning Promotion Online

Moreover, studies have not only sought to look at direct SRL promotion strategies towards learners, but equally indirect promotion through the design of online learning environments (McMahon & Oliver, 2001; Rowe & Rafferty, 2013; Littlejohn, Allison, Milligan & Colin, 2015; Pandero, Klug & Järvelä, 2016). These studies question What SRL promotion entails when it comes to the creation and affordances of the blended and/or fully online course design. In this regard, several tools and studies will be elaborated upon in providing guidance towards how one might approach designing for SRL promotion.

Littlejohn, Allison, Milligan, and Colin (2015), provide a set of design specific recommendations derived from a larger scale project in supporting professional learning in MOOCS. Drawing on several sources of data, the authors put forward six recommendations (as well as identify associated rationales and supportive evidence), towards creating SRL-supportive courses (p.5-7).

**Recommendation 1:** Enable professional learners to link theory learned in the MOOC with their work practice by setting personal goals, or personalising course goals. The integration of expertise developed through the MOOC with expertise gained through professional practice could lead to improved learning.

**Recommendation 2:** Help professional learners to reflect on the knowledge gained from the course and how it may be embedded into their work practice before the end of the course.

**Recommendation 3:** Support professional learners to continually monitor their learning to determine its ultimate value beyond their immediate learning experience.
Recommendation 4: Capitalise on the diversity of motivation, expectation, and prior knowledge and experience that is inherent within all MOOC cohorts.

Recommendation 5: Encourage professional learners to discuss ideas from the course with co-workers in their external professional network as well as with other learners on the course.

Recommendation 6: Utilise the existing knowledge and experience that professional learners bring to the learning context.

Freely shared and elaborated upon in more detail, the aforementioned MOOC Design Recommendations can be consulted in more detail here: https://figshare.com/articles/MOOC_Design_Recommendations/1420557

Rowe and Rafferty (2013), in covering a number of relevant studies on the subject of SRL promotion strategies, also explore the design dimension and conditions necessary to establish “how educators might apply self-regulated learning interventions to the design of e-learning environments in order to support self-regulated learning processes.” In doing so, they cover several necessary e-learning dimensions of design (activities, content, tools, collaboration) worth considering given the impact on SRL (see p.596-599). Moreover, they highlight the necessity of placing focus on “the learning objectives and pedagogical goals and not the tool, as a number of other technologies can be configured to accomplish the same task” (p.596).

Lastly, Panadero, Klug and Järvelä (2016), in their study and identification of various phases of SRL evolution to-date, provide key examples of several existing and emerging computer assisted systems and online scaffolding interventions promoting SRL. The dual objective of these technology-enhanced designs, both research and intervention supportive, allow for insights and consideration of real-time and learner-centred possibilities, in creating enabling environments.

Overall, the various SRL promotion possibilities presented aim to elaborate upon the existing forms of promotion, effective online strategy use, and design-supportive environments. Furthermore, highlighting the affordances of existing and emerging digital technologies aim to provide several rich avenues by which to inform intervention decisions and efforts.
5 PART 3: EVALUATING SELF-REGULATED LEARNING

Having observed the multiple origins of SRL, it is only fitting that as a result of varying definitions (Boekaerts & Corno, 2005; Roth, Ogrin & Schmitz, 2016), and the evolving nature of promotion strategies (Panadero, Klug & Järvelä, 2016), researchers have in turn developed and adapted a number of instruments to measure SRL. The following section aims to briefly highlight the evolution of SRL measurements, and the enabling impact of digital affordances towards existing subjective and objective possibilities. SRL instruments range, measuring dimensions of learners self-regulated learning online, as well as environmental micro (course, tools), and macro (platform), promoting capacities. Ultimately, several challenges worth noting in drawing conclusions are highlighted for practitioners, given the analytical and methodological challenges in research on SRL.

5.1 EVOLUTION OF MEASUREMENTS

In parallel to developments on the theoretical science of SRL, the evolving nature of digital affordances as research tools (e.g. online measures, trace methods, eye-tracking, video data, log data, network analysis, biometric sensors, and physiological insights etc.), has led to new multi-modal possibilities to study (and act upon) learning. This latest evolution in measurement is what some researchers have termed as the ‘third wave of measurement in the self-regulated learning field’ (Panadero, Klug & Järvelä, 2016).

Given the SRL sub-processes’ internal and individual character inherent to learners themselves, several approaches have been found by researchers over the years to overcome the challenge of measuring SRL (Boekaerts & Corno, 2005; Panadero, Klug & Järvelä, 2016; Boekaerts, Pintrich & Zeidner, 2000; Azevedo, 2009). In their recent study, Panadero, Klug and Järvelä (2016), identify and profile three interconnected waves in the history of SRL measurement. The current one, termed ‘the third wave’ is of interest, as it presents a phase where measurement and intervention converge. However, in understanding the emergence and make-up of instruments currently at researchers and practitioners disposal, it is worth briefly elaborating upon the first two identified waves as well.

First Wave: SRL through self-report lenses. This first wave is characterized by SRL measurement instruments whose main sources of information are the learners’ self-reported accounts of SRL. Including methods such as surveys, interviews, and questionnaires, these static conceptualizations rely largely on the individuals in questions beliefs and perspectives, and are not time-sensitive. They therefore, when employed in isolation, poorly capture if at all, SRL developments that may be induced by particular promotional approaches.

Second Wave: The irruption of online measures. From aptitude (trait-based) to event (process-based) acknowledgement, and ‘fly on the wall’ approaches aiming for greater objectivity in measures; the second wave is one resulting from “the conceptualization of SRL to a dynamic series of behavioural, cognitive, metacognitive, motivational, and emotional events”, and the evolution of existing and established SRL models (i.e. Pintrich, 2000; Zimmerman, 2000). Employing measures such as traces, thinking aloud protocols, observations of behaviour (also all termed event measures), they follow students’ actual activity (or situated regulatory processes), during the SRL learning task. This second wave therefore brought forward methods whose aim was to be unnoticeable, minimizing the assessment feeling (and consequently impact) so as to increase the objectivity of measurements.
Third Wave: A New conceptualisation of SRL measurement “intervention + assessment”. Multipurpose and mutually beneficial would be words reflective of the emerging third wave described by Panadero, Klug, and Järvelä (2016). These methods serve a dual purpose, on the one hand allowing researchers to analyse and study SRL processes, whilst equally combining features that serve as SRL promotion tools for the learners themselves (e.g. by enhancing student self-monitoring possibilities, planning and strategy adaptation etc.). One example highlighted by the authors is the practice of asking students to plan, monitor, and reflect on their learning through the use of learning diaries. The process allows researchers to “analyze the students’ diaries and explore the student’s learning actions over a certain period of time” and “simultaneously the ongoing reflection about their actions through the diary has an effect on the students’ prospective learning actions” (p.728).

Taking note of these developments in the field provides greater insight into what might be possible and necessary in measuring SRL. Importantly, it highlights what might be on the one hand promising and scalable, as well as on the other hand feasible and reliable (given its existing empirical evidence-base), in allowing us to draw informed and impactful conclusions and recommendations for the online learning case of Teach-UP.

5.2 SCALES AND MEASUREMENTS

Overall a large number of scales and instruments can be observed within the literature and research on SRL. Although, given the aforementioned understanding that SRL is both multi-dimensional and contextually-based, we can distinguish and will therefore elaborate upon two different types: those that focus on and cover learner determinants for SRL, and those measuring additional impacting SRL determinants.

5.3 MEASURING LEARNER-DETERMINANTS OF SRL

Across these progressive and interwoven waves described, a number of researchers have documented and evaluated actual occurrence of, differences in, and intentions of the validated instruments and procedures that aim to measure learner-determinants (elaborated in Part 1) of SRL. Although numbered, several studies will be identified given their comprehensive coverage and or relevance to this review.

Roth, Ogrin, and Schmitz (2016), conducted a systematic review of the existing literature on self-report instruments. In doing so, they provide a condensed evidence-based understanding of the range of existing self-report instruments, as well as their frequency of use within the field, the contexts of their use, and associated comparative reliability. The strengths, limitations, and distinctiveness of the approach are discussed in greater detail (see p.228-230 for breakdowns). Briefly elaborated below, their findings on measurement characteristics, and a distribution of self-report measurement types are outlined.

Comprehensive characteristics observed in measuring SRL

**Intended measurement focus**: This refers to the specificity of SRL instruments in what they tend to measure regarding SRL development, such as self-efficacy concerning SRL, motivational states, and behavioural strategies.
The degree of situational specificity: Varying in how specific the learning task in question is measured, this characteristic highlights the range observed in self-report instruments in regards to whether tools focus on strategy assessment in a general, domain, course or situation specific manner.

Measurement standards: These are identified as ranging from qualitative to quantitative data collection, and offline (component-oriented), as well as online (process-oriented), standards.

Self-report measurement types:

Questionnaires: The most common form of assessment for reasons of scale as well as the diverse comparatively limited costs of implementing, administrating, and scoring on scale are questionnaires. Assessing a number of aspects in regards to SRL, scoring methods as well as response bias are worth keeping in consideration given noted discrepancies in recounting accuracy.

Interviews: Differentiated from questionnaires, given their open-ended questions, these often enable students to respond to a greater variety than a restricted coverage of strategies. Most of these interviews tend to ask either about SRL dimensions looking at prospective behaviour (referring to hypothetical learning contexts), or retrospective behaviour, and information regarding a learning task.

Think-aloud technique: These strategies aim to assess and understand strategy adoption during students actual learning process, through verbally expressing thoughts whilst undertaking a learning task. The advantage of this approach is therefore the formative registration of students’ thoughts as they take place.

Learning Diaries: As noted these “enable researchers to sensitively measure daily or weekly learning strategies over a certain period of time” (p.230). Moreover, they range in rigidness, from structured to unstructured learning journals, and have been identified to be useful given the allowance for greater sense of openness on behalf of students whilst completing them.

An overview of the instruments found as a result of the study can be seen in Table 2 provided below. That said, given the condensed nature of this report, it would be of value to consult Roth, Ogrin, and Schmit’s (2016), actual study (p.237-240), for a detailed account of the reliability, validity, and implementation history of each of these instruments.

Furthermore, given the limitations acknowledged by the authors in regards to the targeted self-report only nature of their review (Roth, Ogrin & Schmitz, 2016), two other brief and relevant SRL learner-determinant measurements, a tool and approach respectively, are worth mention.

Table 2. Established instruments
### Name of Instrument (acronym; reference) | No.\(^1\) | No.\(^2\) | Total
---|---|---|---
Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich et al. 1991) | 68 | 26 | 94
Learning and Study Strategies Inventory (LASSI; Weinstein et al. 1987; Weinstein and Palmer 2002) | 10 | 2 | 12
Inventory of Learning Styles (ILS; Vermunt, 1998) | 4 | 4 | 8
Academic Self-Regulated Learning Scale (A-SRL-S; Magno 2009a) | 4 | 0 | 4
Online Self-Regulated Learning Questionnaire (OSLQ; Barnard et al. 2008) | 6 | 0 | 6
Self-Efficacy for Learning Form (SELF; Zimmerman and Kitsantas 2007) | 4 | 1 | 5
Self-Efficacy for Self-Regulated Learning Scale (SESRL; Gredler and Schwartz 1997; Ganavalia and Gredler 2002) | 4 | 1 | 5
Self-Regulated Learning Interview Schedule (SRLIS; Zimmerman and Martinez-Pons 1986) | 6 | 3 | 9
Thinking aloud (Azevedo et al. 2004a) | 9 | 0 | 9

\(\text{No.}^1\) Number of studies exclusively using the mentioned instruments  
\(\text{No.}^2\) Number of studies using parts of the instrument within a compilation of measurements


Directly relatable, given the Teach-UP online and MOOC environment, is an instrument resulting from several outputs created as part of a larger study targeting Professional Learning in Massive Open Online Courses (Littlejohn, Allison, Milligan & Colin, 2015). The SRL-Patterns tool is an online survey instrument. The tool takes into account the overarching phases of SRL (Zimmerman, 2000), whilst measuring various sub-processes in a two-phased approach (large-scale survey and semi-structured interviews). The approach employed aimed to firstly generate individual profiles of how all participants self-regulated their learning (using the online survey), and consequently to select participants on a descriptive and/or other dimension of interest (e.g age, profession, SRL profile high or low etc.) for a semi-structured interview. The following approach is therefore potentially of interest for Teach-UP given scalability as well as insights onto SRL progression for diverse target groups (ex. pre-service and in-service teachers). Freely shared and elaborated upon in more detail, the aforementioned tools can be consulted here:

The online survey instrument to measure self-regulated learning (SRLMQ):  
[https://figshare.com/articles/SRLMQ/866774](https://figshare.com/articles/SRLMQ/866774)

The semi-structure interview script (PL-MOOC):  
[https://figshare.com/articles/PL_MOOC_Semi_structured_interview_script/866773](https://figshare.com/articles/PL_MOOC_Semi_structured_interview_script/866773)

Although Roth, Ogrin and Schmitz (2016) mentioned earlier, emphasise the importance of not discrediting and instead exploiting more intensively the use of self-report advances and potential in online learning; we would argue that the combination of these with other measurement instruments is of great value and necessity for Teach-UP (Panadero, Klug & Järvelä, 2016; Järvelä et al., 2015; Carneiro, Lefrere & Steffens, 2007; Winne, 2014; Azevedo, 2009).
Examples demonstrating the possibility of studying SRL through multi-modal approaches whilst situating oneself at the forefront of SRL practice (‘third wave SRL’ intervention+evaluation), can be observed in multiple ongoing practices (Lang, Siemens, Wise & Gasevic, 2017). These initiatives are combining existing lines of research into the application of both open and closed system computer-based tutoring and scaffolding to promote SRL (Winne & Hadwin, 2013; Azevedo, Johnson, Chauncey, & Burkett, 2010; Carneiro, Lefrere & Steffens, 2007; Greene & Azevedo, 2010; Panadero, Klug & Jarvela, 2016; Lang, Siemens, Wise & Gasevic, 2017). The combination of software and tools employed serve two functions, on the one hand promoting SRL strategies via multiples aids, analytical advances and/or pedagogical agents (elaborated in Part 3), and on the other hand empowering researchers with multi-modal records of student actions (traces), which allow for insight into different SRL strategy uses.

As was noted earlier, the emphasis placed by researchers within the different (and guiding) SRL frameworks (Panadero, 2017; Roth, Ogrin & Schmitz, 2016; Panadero, Klug & Järvelä, 2016; Puustinen & Pulkkinen, 2001; Boekaert, Pintrich & Zeidner, 2000), distinguishes between measuring SRL as an ‘aptitude’ (static component measurement), versus as an ‘event’ (process and phase coverage). Additionally, differences also exist regarding the levels or domain specificity of measures, learners asked about and/or SRL measured in general, versus SRL measured on a particular task/course. Overall, self-regulated learning is a dynamic process, that involves domain and situationally specific skillsets, whom in turn vary dependent on tasks and learning environments (e.g. see Roth, Ogrin and Schmitz, 2016, p. 226).

Acknowledging these various SRL determinants, it is worth recognizing therefore the different sensitivities and insights that particular approaches might allow us to conclude about learners SRL, and/or their SRL in regards to, and/or during specific tasks (Roth, Ogrin, Schmitz, 2016). Therefore, one’s selection of measures and design to measure must fulfil, and/or reflect, what it is they aim and intend to draw conclusions upon for with the decided intervention (Fontana, Milligan, Littlejohn & Margaryan, 2015; Fournier, Kop, & Durand 2014; Panadero, Klug & Järvelä, 2016).

5.3.1 Measuring impacting SRL determinants: Online Environment and Tools

As highlighted earlier in the introduction, within the SRL framework components, and the SRL promoting possibilities, context matters. Therefore, if these determinants are acknowledged as impacting actual SRL for learning and/or teaching (Lynch & Dembo, 2004; Lombaerts, Engels, & van Braak; 2009; Peeters et al., 2013; Carneiro, Lefrere & Steffens, 2007), as well as being employed as levers towards promotion and/or support of SRL (Littlejohn, Allison, Milligan & Colin, 2015; Roth, Ogrin & Schmitz, 2016), it is only fitting that their capacity to actually do so, can be measured. Therefore, it is worth taking note of two different approaches, and possible tools that have been created to measure the online learning environment.

As part of work funded by the Bill and Melinda Gates Foundation MOOC Research Initiative, the ‘MOOC-Design Team Questionnaire’ (MOOC-DTQ), targeted as both a research and a course designers self-administering tool, was created. The following analytic instrument was developed as a result of a multi-step and rigorous process of scientific evaluation on existing empirical articles, desk research, and targeted interviews into online learning contexts (Littlejohn, Allison, Milligan & Colin, 2015). Intended to serve as a post-design audit instrument for macro (platform), and micro (course) determinants, it contains 54 items that aim to “examine the design decisions underlying MOOC environment and learning design”, as well as instructors perceived insights on learner course engagement and perceptions (Littlejohn, Allison, Milligan & Colin, 2015, p.5). In doing so, the items are
structured in reflection of SRL phases and sub-processes (highlighted earlier in the SRL frameworks section), with each question probing whether the design is encouraging of particular SRL behaviours i.e. whether “it supports, or fails to support learners self-regulating their learning” (p. 8). Freely shared and elaborated upon in more detail, the MOOC-DTQ can be found here: https://figshare.com/articles/PL_MOOC_Design_Team_Questions_draft_/907150

Taking a different approach, and broader lens on the potential contextual SRL determinants in technology-enhanced learning environments, the scientific literature and expert deliberated TELE-SRL and TELEStudents-SRL survey instruments were created. These aim to assess to what extent a particular environment is equipped to support SRL phases, and sub-processes for a particular learning task. Similar in structure they are differentiated in their approach by their target perspective under research, the former (TELE-SRL) is designed for researchers, course instructors and/or designers, and the latter (TELEStudents-SRL) as the name denotes, is slightly shorter and tailored to gather judgements and perspectives from students employing the environment to fulfil their respective learning objectives (Carneiro, Lefrere & Steffens, 2007). Freely shared and elaborated upon in more detail, the aforementioned tools can be consulted here: http://www.lmi.ub.es/telepeers/telestudents_srl.php

5.3.2 Navigating Challenges in Measuring SRL

As is the case with any measurement, be it regarding the SRL measurement approach chosen (process or component), the domain specificity, the mode and medium of collection (self-report, trace etc.), and the associated potentials for bias (objective and subjective accounts), they all have limitations (Roth, Ogrin & Schmitz, 2016; Panadero, Klug & Järvelä, 2016; Fournier, Kop & Durand, 2014; Azevedo, 2009; Carneiro, Lefrere & Steffens, 2007). This implies that there are equally risks in drawing conclusions based on these instruments outputs, that one must be aware of, in drawing reasonable and informed SRL-based intervention conclusions whilst employing them. Several key recommendations have therefore been put forward across the literature, to mitigate and maximise accuracy, of SRL supportive experimental interventions.

- Select the tools that reflect your needs.
- Incorporate and Acknowledge ongoing intervention needs for quality.
- Think about the potential differences within contexts implied.
- Combine measurements for meaning.

Therefore, in concluding and aiming to round-up this measurement section, particularly given the complexity of capturing learners SRL, and risks entailed in combining instruments, the checklist created by Panadero, Klug and Järvelä (2016) proves informative. As can be observed below (see Table 3), the checklist provides a helpful way to reflect upon and consider various aspects when designing how one will go about evaluating and measuring an intervention. Furthermore, in being rooted within the emerging ‘third wave’ of measurement i.e thinking about tools as evaluation mechanisms as well as empowering learner SRL development (Panadero, Klug & Järvelä, 2016), it proves comprehensive and progressive (up to date with the empirical literature) in its points of consideration.

Table 3. Checklist including aspects to consider when designing measurement + intervention methods
Considerations for creating or choosing a measure
1. Consider the SRL cycle and embed it in the tool
   1.1 Consider when to measure: before, during, and/or after learning, depending on the tool
   1.2 Consider cognitive load
2. Consider validity
   2.1 Choose a natural learning setting in terms of ecological validity
   2.2 Consider memory and lack of calibration effects
   2.3 Rely on a model in terms of content validity
   2.4 Check criterion validity (e.g. effect on academic performance, self-efficacy, etc.)
3. Consider task/item format
   3.1 Consider measuring economically and stimulating reflection
   3.2 Consider which approach to choose, quantitative and/or qualitative
   3.3 Consider standardized and/or open-ended items

Considerations for the procedure
1. Model use of instruments
   1.1 Provide examples
2. Create commitment
   2.1 Make potential explicit
   2.2 Use rewards if necessary

Considerations for the study design
1. Consider triangulation with other measures that do not intervene
   1.1 Consider a combined pre-post and process design
   1.2 Consider collecting baseline and stability data
2. Consider adding a control group
   2.1 Consider entangling the intervention effect of the instrument by a control group
   2.2 Consider a waiting control group for ethical reasons
3. Consider longitudinal or even time-series designs
   3.1 Consider the intervals for measurement
   3.2 Consider how many occasions are needed for the type of analysis

Considerations for practical implications
1. Consider instructing students about watching their learning curves
2. Consider providing (automatically produced) feedback about students’ learning curves
3. Consider adapting teaching and developing tailored training programs

6 CONCLUSION

In summation, the following report aims to cover a number of important dimensions in defining, promoting, and evaluating self-regulated learning, and more specifically self-regulated learning online. The report highlights the necessity and benefits of SRL given the online learning demands and professional development of teachers. It further proceeds to provide a shared understanding by which diverse stakeholders can define SRL, informed and derived from well-established models and the consensus rooted in a scientific evidence base. Parts two and three in turn provide a comprehensive overview of the literature and existing current and emerging approaches and tools, with the aims of allowing for the design (promotion and evaluation) of impactful SRL interventions online. Ultimately, these aforementioned practices and possibilities, rooted in the state of the art, aim to provide impetus for informed SRL discussion whilst targeting Teach-UP’s proposal aims.
7 REFERENCES


