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Exploring Self-Regulated Learning in Digital Education: Learning design, technology and practice

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Introduction
Self-Regulated Learning and Digital Education: Overcoming the main concerns

Maria Ranieri, Albert Sangrà

1. SuperRED. An overview

This book collects and illustrates the main theoretical, methodological and empirical results of the European project *Supporting Self-Regulated Learning in Digital and Remote Education* (SuperRED), funded by the European Commission within the framework of the Erasmus+ program for the period 2022-2024 and involving researchers and school partners from Italy, Spain, Belgium, and the Netherlands. The project was conceived as a critical response to the digital educational challenges emerged during the Covid-19 pandemic to address key horizontal priorities such as "Addressing digital transformation through development of digital readiness, resilience, and capacity", as well as specific priorities associated to school education for the "Development of key competences".

As well known, the pandemic's abrupt cessation of face-to-face teaching worldwide accelerated the digital transformation of education (Bond, 2020; Nurhas et al., 2022), while highlighting and exacerbating existing issues within educational systems (Carretero Gomez et al., 2021), particularly concerning the school's digital readiness and the capacity for effective remote learning. This sudden shift, termed *Emergency Remote Education* (ERE), showed

substantial gaps in both teacher and student digital preparedness, as documented in several studies referred to the Covid-19 period (see, for example, Carretero Gomez et al. 2021; Giovannella, Passarelli & Persico, 2020; INDIRE, 2020; Ranieri, Gaggioli & Kaschny Borges, 2020).

SuperRED intended to develop and implement a strategy to approach these challenges, based on the elaboration of innovative tools and methodologies for enhancing both teacher and student digital competences for teaching and learning. Central to this effort was the creation of a comprehensive framework for effective and inclusive digital and remote education. This framework supported the upscale of already existing tools such as the 4Ts (Task, Time, Team, Technology) game for teachers' Learning Design (LD), created by the project partner ITD-CNR, or the development of a new educational app to Self-Regulated Learning (SRL) among students. These resources aimed to not only meet immediate needs during the pandemic but also to build medium and long-term resilience within the educational system.

A critical aspect of the project was the professional development of teachers, who often felt unprepared to reshape traditional classroom practices to the digital settings. This was particularly challenging in countries like Italy and Spain, where the replication of face-to-face dynamics in online environments led to mixed outcomes and a loss of engagement with a significant portion of students (Carretero Gomez et al., 2021). Similar issues were also evident in Belgium, where challenges included low digital skills among educators and an increased workload.

For students, the shift to remote learning highlighted the need for greater self-management and autonomy in their learning processes. In several cases, the lack of immediate feedback and peer interaction increased stress and potentially decreased motivation (Donnelly & Patrinos, 2022). SuperRED's initiatives focused on promoting SRL and collaborative learning through digital tools, tackling these challenges to prevent disengagement and learning

loss. The project recognized the importance of asynchronous and collaborative learning models, particularly in mitigating the risks associated with limited internet access or with the feeling of isolation.

Prior to providing further details on the project and its results, we go deeper below in the discussion of the rational for the project and in the presentation of its theoretical underpinnings.

2. SuperRED background and rational

As already observed, the sudden and widespread adoption of remote learning highlighted significant gaps in the educational landscape. According to the School Education Gateway Survey (2020), a significant proportion of teachers were teaching online for the first time, revealing a lack of competences in digital LD and supporting students' SRL. Some studies emphasized how traditional teaching strategies that are typically adopted in face-to-face schooling (e.g., video lectures with explanations, homework, textbooks, etc.) were merely replicated during the distance learning period (INDIRE, 2020). Other research showed how teachers were generally unprepared to manage teaching with digital tools (Ranieri et al., 2020), which likely led to many teachers (84%) attending training courses during the lockdown (INDIRE, 2020). Further studies pointed to gaps in instructional design (OECD, 2020), where activities were not specifically redesigned for the online setting but were merely transposed with some time and content adjustments. School dropout and the management of assessment processes emerged as major challenges (SIRD, 2020). The difficulties in rethinking traditional assessment methods (such as oral exams or written tests), which were largely inadequate for digital teaching, caused significant disorientation among teachers.

While highlighting teachers' unpreparation to digital educa-

tion, the experience of distance learning due to the health emergency also highlighted the limitations of the current situation, prompting us to move beyond the oppositions between face-to-face and distance education in terms of quality teaching (Ranieri, 2020). First of all, as we noted, teachers often felt unprepared to face the emergency by resorting to teaching supported by technologies, revealing a lack of skills that points to the issue of teacher training. The shortcomings did not pertain to technology per se, but to the ability to redesign teaching in accordance with the changed educational setting. From this perspective, improving teachers' design capabilities is necessary (Williamson, Eynon, & Potter, 2020), especially considering the tendency that emerged during the pandemic to adopt predominantly transmissive teaching models. In a period of physical and social distancing among students, the use of cooperative teaching strategies could have promoted social interactions with positive returns not only on learning but also on socio-relational aspects. Collaborative teaching can leverage project work, problem-solving, information search, and shared product construction, but these methods need to be carefully planned and managed. Since today's digital platforms are capable of supporting dialogic exchange and collaborative production, teacher training should be aimed at enhancing understanding of the affordances of digital tools for technological-pedagogical design, fully aware of the strengths of electronic environments that support cooperation. At the same time, teacher training should pay specific attention to the challenges of the digital setting, such as the autonomy of the students who have to be able to manage and self-regulate their own learning process. During the months of distance learning, students had to organize their study activities on their own, but not all of them were able to do so, placing a heavy burden on families -sometimes also unable- or compromising the quality of their learning. In cases of distance or blended learning, it is crucial to foster the development of students' self-regulation skills by using method-

ological supports useful for planning and organizing work on one hand and for self-monitoring with possible behavioral adjustments on the other. Moreover, the evaluation systems during remote learning often relied on video calls and online meetings, which presented unique challenges. The lack of robust digital evaluation tools made it difficult to assess students' progress accurately. Teachers found it challenging to adapt traditional assessment methods to a digital format, often resulting in a less comprehensive evaluation of student performance (Conole, 2012; Goodyear & Dimitriadis, 2013).

Despite the challenges, the pandemic also highlighted the potential for digital education to transform teaching and learning processes. Innovative tools and game-based learning approaches, such as those developed by the SuperRED project, supported teachers in designing learning paths that scaffold students' achievement of SRL and collaboration competences in a digital context (Ranieri, 2020). These tools also aimed to reduce early school leaving and educational poverty by addressing the specific needs of both teachers and students in adapting to remote and blended learning environments.

Given this rationale this is the reason why the SuperRED project's systemic approach was instrumental in addressing the multifaceted challenges posed by the shift to digital education during the pandemic. By providing comprehensive training for teachers and developing innovative digital tools for students, the project not only addressed immediate educational needs but also laid the groundwork for a more resilient and adaptable educational system capable of withstanding future crises.

3. SuperRED structure and main results

The SuperRED project was promoted by the University of Florence (UniFI) (Italy), which coordinated a mixed group of organ-

izations, including three research institutions, i.e. the Institute for Educational Technology - National Research Council (CNR-ITD) (Italy), the Delft University of Technology (TUDelft) (The Netherlands), the Open University of Catalonia (UOC) (Catalonia, Spain), and three schools, i.e. Bernardus (Belgium), ISA13 (Italy), Escola Solc (Catalonia, Spain). The participation of research institutes within the partnership brought a high level of scientific competence and research in the field of self-regulated and digital learning, while, the presence of schools provided a direct connection with the main actors of the educational context, that is teachers and students. The cooperation between researchers and teachers allowed the project to identify realistic and useful solutions which proved to be appropriate to teachers' and students' actual needs. Through the integration of research and practice perspectives, the SuperRED project benefited from an evidence-based approach, ensuring that the developed solutions were both theoretically sound and effectively applicable in school contexts across different countries. Moreover, the interaction and collaboration among schools and research institutes facilitated a constant flow of feedback, mutual learning, and knowledge sharing, and the refinement of the proposed tools.

The SuperRED primary objectives were to empower students by enhancing their autonomy in managing learning processes and to equip teachers with the necessary skills for effective digital lesson design. These objectives were realized through the development and implementation of several key tools and methodologies. As mentioned above, the first step towards the achievement of these objectives was the elaboration of a framework for effective and inclusive digital and remote education. This framework laid the foundation for the development of two main tools: the SRL-4T tool, also known as the 4Ts game, which assisted teachers in the LD process for supporting students' SRL and an educational app designed to foster SRL among students. These tools were complemented by collaborative educational

scenarios, which were thoroughly tested through two implementation cycles which were carried out in the partner schools.

The self-reported perceptions from the first and second testing cycles, collected via pre-post surveys administered to both teachers and students, revealed consistent improvements in both teachers' LD skills and students' SRL capabilities. Teachers reported significant enhancements across all phases of LD, with particularly notable gains in the planning and authoring phases. The 4Ts game was well-received, with teachers appreciating its engagement, motivational value, and utility.

Students also demonstrated considerable progress, especially in the performance and self-reflection phases of SRL. The second cycle showed a significant increase in students' self-reflection abilities. Moreover, there was a marked shift in students' selection of learning content, with a growing preference for content that was personally interesting or selected by peers, as opposed to merely following teacher suggestions.

Briefly, we can say that the SuperRED project successfully met its objectives, leading to significant advancements in the digital competences of both teachers and students. The project demonstrated a robust capacity for adaptation and improvement, as evidenced by the positive trends observed across the two pilot cycles. However, it also highlighted the ongoing need for support and refinement, particularly in enhancing digital competence and overcoming implementation challenges.

The project culminated in the publication of a *SuperRED Toolkit* and this comprehensive book, both of which serve as valuable resources for disseminating the project's findings and insights. These publications target a broad audience, including researchers, educators, and policymakers, thereby fostering further developments in digital education.

Overall, the SuperRED project has proven to be an effective initiative in enhancing LD and SRL skills, paving the way for more effective and resilient educational strategies in the future.

4. This book

This book includes seven chapters which illustrate the theoretical and methodological underpinnings of the project as well as its empirical and operational results. Chapter 1, *Designing collaborative learning activities for the development of self-regulated learning skills* by Donatella Persico, Francesca Pozzi and Marcello Passarelli, examines how LD has evolved to emphasize learner-centered approaches, focusing on the development of SRL skills. It introduces the 4Ts model - Task, Teams, Time, and Technology - as a framework for designing effective collaborative learning activities. The chapter also highlights the importance of SRL, which involves learners actively managing their learning through goal-setting, monitoring, and self-regulation, while discussing the challenges and strategies for fostering SRL, particularly in online and collaborative environments. A rubric for educators to assess and enhance their LD to better support SRL is also provided as a valuable methodological tool.

Following the chapter providing the theoretical background, Chapter 2, *Framework design for effective and inclusive Digital and Remote Education* by Maria Ranieri, Gabriele Biagini, Alice Roffi and Stefano Cuomo, introduces the SuperRED framework, including its genesis and objectives. Prompted by challenges revealed during the COVID-19 pandemic, the framework integrates insights from a literature review and teacher surveys to address gaps in digital education. It provides practical guidelines focused on LD, tools, technologies, and Learning Ecologies (LE), aiming to enhance digital readiness and support adaptable, inclusive teaching practices across various educational contexts.

The subsequent three chapters shift the focus from the theory to methods and tools starting with Chapter 3, *The SRL-4Ts game: a tool to foster the design of collaborative learning activities oriented to self-regulated learning* by Marcello Passarelli, Francesca Pozzi, Flavio Manganello and Donatella Persico. This chapter is devoted

to the SRL-4Ts game, a tool developed to help teachers design learning activities that promote SRL in students. The game consists of two modules: the 4Ts Core Module, which aids in creating collaborative LD, and the SRL Module, which focuses on enhancing SRL through reflective practices. Available in tangible, digital, and hybrid formats, the game is designed to be flexible and adaptable to various educational contexts, supporting teacher training and professional development in fostering SRL. Chapter 4, *Design-Based Research: A methodological approach to the design and validation of the SuperRED components* by Maria Ranieri, Alice Roffi and Gabriele Biagini, explains the SuperRED methological approach for implementation and testing, which was based on Design-Based Research (DBR). DBR, an iterative and collaborative research method, was used to develop and refine educational scenarios aimed at enhancing teachers' LD skills and promoting students' SRL. The chapter outlines the DBR process, including problem analysis, solution development, iterative testing, and reflection, highlighting how it informed the creation of effective and context-sensitive educational interventions within the SuperRED framework.

Chapter 5, *Design and development of an educational app addressing students' self-regulated learning* by Shirong Zhang and Marcus Specht, discusses the design and development of the GoaLearn app, an educational tool aimed at enhancing SRL for students aged 10-15. The app is based on Zimmerman's model of SRL and provides features that guide students through goal-setting, task management, and reflective practices, supporting their learning across various subjects. Teachers and administrators also benefit from the app's dashboards, which allow them to monitor students' progress and support their self-regulation efforts.

The main findings of the SuperRED project are described and discussed in the two final chapters. Chapter 6, *Educational scenarios implementation, insights from teachers and students on learning*

design and self-regulated learning by Alice Roffi, Gabriele Biagini and Stefano Cuomo, presents the outcomes of the SuperRED project's implementation and testing phases. It evaluates the effectiveness of the SuperRED approach in enhancing teachers' LD skills and students' SRL abilities through iterative cycles of design, testing, and refinement. The chapter highlights improvements in both teachers' LD competences and students' SRL skills, particularly in the performance and self-reflection phases. While the approach showed positive results, ongoing refinements, especially in digital competence and tool familiarity, are necessary to fully realize its potential in diverse educational settings. Lastly, Chapter 7, *Learning Ecologies and Self-regulated learning: Comparative analysis of students across Catalonia, Italy, and Belgium* by Marc Romero, Montse Guitert, Teresa Romeu and Dèlia Español, examines the diverse learning environments and practices of students in the three partner countries. Through a comprehensive survey, the chapter explores differences in extracurricular activities, resource preferences, and social relationships, and how these elements shape students' learning experiences. The findings highlight the influence of cultural and educational contexts on students' SRL and provide insights into how educational practices can be optimized across different European settings.

References

Bond, M. (2020). Schools and emergency remote education during the COVID-19 pandemic: A living rapid systematic review. *Asian Journal of Distance Education, 15*(2), 191-247. https://www.asianjde.com/ojs/index.php/AsianJDE/article/view/517.

Carretero Gomez, S., Napierala, J., Bessios, A., Mägi, E., Pugacewicz, A., Ranieri, M., Triquet, K., Lombaerts, K., Robledo Bottcher, N., Montanari, M., & Gonzalez Vazquez, I. (2021). *What did we learn from schooling practices during the COVID-19 lockdown.* Publications Office of the European Union. https://op.europa.eu/en/publication-

detail/-/publication/1e0ccef2-509f-11eb-b59f-01aa75ed71a1/language-en

Conole, G. (2012). *Designing for learning in an open world*. Springer.

Donnelly, R., & Patrinos, H.A. (2022). Learning loss during Covid-19: An early systematic review. *Prospects, 51*, 601–609. https://doi.org/10.1007/s11125-021-09582-6.

Giovannella, C., Passarelli, M., & Persico, D. (2020). Measuring the effect of the COVID-19 pandemic on the Italian Learning Ecosystems at the steady state: a school teachers' perspective. *Interaction Design and Architecture(s) Journal, 45,* 264-286. https://doi.org/-10.55612/s-5002-045-012.

Goodyear, P., & Dimitriadis, Y. (2013). In medias res: Reframing design for learning. *Research in Learning Technology, 21*. https://doi.org/-10.3402/rlt.v21i0.19909.

INDIRE (2020). *Indagine tra i docenti italiani pratiche didattiche durante il lockdown. Report preliminare*. http://www.indire.it/wp-content/uploads/2020/07/Pratiche-didattiche-durante-il-lockdown-Report-2.pdf.

Nurhas, I., Aditya, B. R., Jacob, D. W., & Pawlowski, J. M. (2022). Understanding the challenges of rapid digital transformation: the case of COVID-19 pandemic in higher education. *Behaviour & Information Technology, 41*(13), 2924-2940. https://doi.org/10.1080/-0144929X.2021.1962977

OECD (2020). *School Education during COVID-19. Were teachers and students ready?* OECD Publishing.

Ranieri, M., Gaggioli, C., & Borges, M. K. (2020). La didattica alla prova del Covid-19 in Italia: uno studio sulla Scuola Primaria / A Didática à prova pelo Covid-19 na Itália: um estudo sobre os Anos Iniciais do Ensino Fundamental. *Práxis Educativa, 15*. https://doi.org/10.5212/PraxEduc.v.15.16307.079

Ranieri, M. (2020). La Scuola dopo la DaD. Riflessioni intorno alle sfide del digitale in educazione. *Studi sulla Formazione, 23*, 69-76. http://doi.org/10.13128/ssf-12316.

Schleicher, A. (2020). *The impact of COVID-19 on education insights from education at a glance 2020*. OECD Publishing.

School Education Gateway Survey (2020). https://www.schooleducationgateway.eu/en/pub/viewpoints/surveys/survey-on-online-teaching.htm

SIRD (2020). *Per un confronto sulle modalità di didattica a distanza adottate nelle scuole italiane nel periodo di emergenza COVID-19*. https://www.sird.it/wp-content/uploads/2020/07/Una_prima_panoramica_dei_dati.pdf

Chapter 1.
Designing collaborative learning activities for the development of self-regulated learning skills

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1.1 Designing for learning

In an effort to respond to the challenges currently faced by school systems in many countries (see the Introduction to this book), research on Educational Technology is devoting much attention to how to support teachers and educators in the complex task of designing effective teaching and learning activities. The goal of these efforts is supporting educators to take the most from the available technological innovations by integrating technologies in education through a systematic approach and pedagogically-aware methods. This particular research strand is known as the "Learning Design" field (LD).

Over the past decade, the field of LD has garnered significant attention from both researchers and practitioners. However, it is firmly anchored in the much older discipline of Instructional Design (ID). The origins of ID can be traced back to World War II (Reiser, 2001), when the United States made substantial investments to systematise the design of educational programs and courses, aiming to enhance the effectiveness and efficiency of edu-

cation and training processes, particularly for critical skills and large audiences. The ID field has progressed in parallel with advances in learning theories and technology. Its primary goal has been to develop methods and tools to make the design and delivery of instruction as systematic, efficient, and effective as possible. According to most ID models (Persico, 1997), the development of an instructional system begins with an analysis of learning needs and contextual requirements, followed by the definition of specifications and the identification of appropriate approaches and tools. This process culminates in the development or selection of necessary educational resources and assessment tools. The delivery phase involves the actual implementation of the instructional process and includes the collection of data for ongoing evaluation and refinement. Several authors (Gustafson & Branch, 2002; Van Rooij, 2010) refer to this approach as the ADDIE model (an acronym for Analysis, Design, Development, Implementation, and Evaluation) and describe it as a sequential and iterative process for systematically developing instructional systems. Although evaluation comes last in the ADDIE acronym, it is generally recognized that it should occur as early as possible to minimise the costs of amending the design. Interestingly, a thorough investigation into the origins of this acronym revealed that there is no original, authoritative version of the ADDIE model in the literature (Molenda, 2003). Instead, ADDIE serves as an umbrella term for a family of models that share the common underlying structure described above. Therefore, ID methodologies include approaches for defining and using quality control measures aimed at collecting data to perform formative evaluation of the instructional process being developed. This data is collected before, during, and after delivery (Persico & Pozzi, 2015).

While the results of ID research have proven very useful for optimising the development of large instructional programs, they are more challenging to apply to small-scale, everyday education. Consequently, the design of educational interventions for indi-

vidual teachers and designers remains an artisanal practice, effectively compared by Conole (2013) to the performance of a juggler balancing educational aims, target population features, available technology affordances, and learning context constraints.

More recently, the term "Learning Design" has come into use. This term, emphasising learners' rather than teachers' agency, the centrality of learning rather than instruction, has almost replaced "Instructional Design", at least in Europe. The term originated from the work of two OUNL researchers (Koper & Manderveld, 2004) who developed the IMS-LD specification and an Educational Modelling Language to enable the expression of learning units embodying various pedagogies. Today, however, this term is used in a much broader sense, mainly in Europe and Australia, by researchers focusing more on facilitating teachers in the creation, sharing, modification, and reuse of their designs for teaching/learning activities (Conole, 2010; Dobozy, 2011; Mor & Craft, 2012).

However, in the authors' opinion, the primary difference between the fields of LD and ID is not merely terminological or related to the embraced learning theories. The main difference lies in the focus of attention: ID primarily aims to provide methodological support to systematise the design process of large instructional projects, involving teams of developers and addressing large cohorts of learners, whereas LD researchers primarily work to support the design, sharing and reuse of learning activities by teachers for their daily classes.

Research in LD views the design process as mainly a collaborative inquiry undertaken by teachers (Mor & Mogilevsky, 2013) and posits that creating communities of educators who share experiences and practices is a necessary, though not sufficient, condition for enabling educators to make better-informed choices when confronted with design problems (Laurillard, 2012; Walmsley, 2012; Persico & Pozzi, 2015). To foster the development of these communities of practice, LD researchers have been working

to provide powerful conceptual and technological tools to support the creation, sharing, reuse, and reflection needed to make the design process more systematic, pedagogically informed, and ultimately effective (Earp, Ott & Pozzi, 2013).

Generally speaking, according to LD researchers, the design process can be structured into three main phases: the conceptualisation phase (i.e. the initial phase of design, when learning objectives and contents are defined, along with the main learning strategies and activities are conceived at a macro-level), the Planning and Authoring phase (i.e. when the activities are micro-planned and the tools and resources for delivering them are prepared and set up), and the Implementation phase (when activities are actually delivered and data are collected to monitor and evaluate the process) (Pozzi et al., 2020). Both conceptual and technological tools have been developed to support teachers in the LD process.

Among the conceptual tools proposed in the LD field, several models have been devised for scaffolding the design process, mainly at the conceptualisation phase. These models are supposed to help teachers and educators to identify learning strategies and activities that are in line with the learning objectives to be achieved, fit in well with the addressed contents and take into account the characteristics of the context and target population (Persico et al., 2013). Among the technological tools, most of them are aimed to support one or two LD phases and are often based and rooted on one of the above-mentioned models, a few are supposed to support the whole design cycle, from the conceptualisation to the Implementation phase (Pozzi et al., 2015; Pozzi et al., 2020).

In the following section, we describe one particular LD conceptual model, called the "4Ts model", which can be used in particular to support the design process of collaborative learning activities. The associated LD tool, aimed to support the conceptualisation design phase, is described in Chapter 4.

1.2 Designing for collaborative learning activities

Theoretically speaking, the need for a conceptual model to support the design of collaborative learning activities, is determined by the intrinsic complexity of the design task when collaborative learning is the desired outcome (Lakkala, 2007). The variables at play in the decision making process and their interactions require thorough consideration of pros and cons of all the design choices made.

The 4Ts model (Pozzi & Persico, 2013) defines and frames collaborative learning activities in terms of four elements: the Task (the activity that students are requested to carry out); the aggregation in Teams (the way students are grouped for tackling tasks), the Time (the task phases and their scheduling), and the Technology (the environment in which the activity takes place, with its tools and resources).

Any time teachers start designing a collaborative activity, they need to define the intended learning objectives to be achieved by the students, to identify the contents to be addressed and to analyse the context (in terms of contextual constraints and characteristics of the target population). Then, they will need to choose a Task to be assigned to students, the Technologies that will be used to accomplish the Task, the social structure of the class (i.e. its organisation in Teams), as well as the Time schedule. As represented in Figure 1, any choice made on one of the variables impacts on all the others, so the design process is iterative in nature (Pozzi & Persico, 2013).

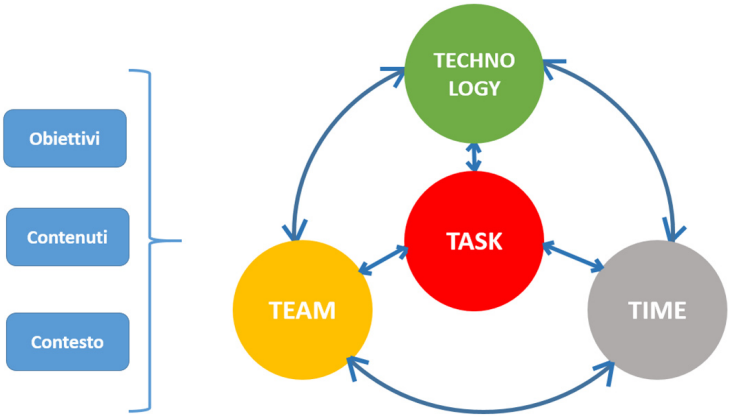

Figure 1. The 4Ts model

Thus conceived, any collaborative activity can be described in terms of the 4Ts (Task, Time, Team, Technology).

In order to support teachers when they are not yet familiar with the notion of collaborative learning, it is possible to use 'collaborative Techniques'[1] (Pozzi & Persico, 2011) that are patterns, or models, of already existing collaborative activities. They are content-independent and can be taken up and adopted to specific contexts. Examples of these collaborative Techniques include: Brainstorming, Discussion, Peer Review, Case study, Role Play, Jigsaw, Pyramid. All the collaborative Techniques can be described in terms of the 4Ts, i.e. by specifying the Task(s), Technologies, Teams and Time that "compose" the Technique at hand.

As already mentioned, the 4Ts model was implemented in a LD tool, called "4Ts game" that is presented in Chapter 4.

1 In the scientific literature this notion is also referred to as collaborative scripts (Dillenbourg & Hong, 2008; Dillenbourg & Jerman, 2007; Kollar et al., 2006; Weinberger et al., 2004; Fischer et al., 2007) or Collaborative Learning Flow Patterns (Hernández-Leo et al., 2005).

1.3 The notion of Self-Regulated learning

In an ever-evolving educational and technological landscape, the ability for students to effectively manage their own learning processes in technology rich environments has become crucial. Schools today must prepare young people to live, work, and engage in future and mostly unknown social, digital, political, and global ecosystems. Regardless of the country they reside in or the communities they become part of, today's students need to be equipped with the skills that will allow them to lead fulfilling lives in a world that we do not know, with jobs that do not exist yet. This means they need to take responsibility for their learning, monitor their learning processes, and assess their success or failures effectively. The skills needed for this can and should be learnt gradually, through practice. Consequently, teachers should strive to foster and support such practice not only because these skills enhance academic performance, but also because they are key for lifelong learning (Paris & Paris, 2001).

Against this backdrop, in the last decades, educational psychologists and researchers involved in the Educational Technology field have investigated Self-Regulated Learning (SRL), a complex construct referring to the process that learners use to systematically focus their thoughts, feelings, and actions on attaining their learning goals, and through which they become masters of their own learning (Pintrich, 2000, 2004; Schunk & Zimmerman, 2012).

According to Pintrich (2000) SRL is "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" (p. 453). SRL therefore encompasses cognitive, metacognitive, motivational, emotional/affective, and behavioral components of learning processes (Azevedo et al., 2012; Panadero, 2017).

SRL skills are recognized to be of paramount importance to engage in knowledge construction and become lifelong learners, enabling them to live productive, meaningful, and healthy lives (Azevedo et al., 2012; English & Kitsantas, 2013; EU Council 2002; NRC, 2012). Therefore, ensuring students develop the ability to self-regulate their learning is regarded as one of the major goals of education (NRC, 2012; OECD, 2018).

Yet, the complexity of SRL poses challenges to students' ability to spontaneously become self-regulated learners. Current research has highlighted direct instruction as an essential and critical component in engaging students in SRL (An & Reigeluth, 2012; Azevedo & Hadwin 2005; Dignath-van Ewijk, Dickhauser, & Büttner 2013; Lee & Hannafin, 2016; Moos & Ringdall, 2012; Moote, 2019; Moote et al., 2013; Winne & Perry, 2000; Zimmerman, 2015). Hence, research in the way teachers can support the development of students' SRL skills and the role technology plays in such development is increasing (Bartolomé et al, 2011; Dignath-van Ewijk & van der Werf, 2012; Dignath & Mevarech, 2021; Greene, 2021; Persico, 2022).

The importance of SRL cannot be overstated. Research consistently shows that students who practice SRL achieve higher academic outcomes, exhibit greater persistence, and possess a stronger sense of self-efficacy. They are better equipped to face challenges and setbacks, using strategic thinking to overcome obstacles and achieve their goals (Zimmerman, 1990, 2001; Broadbent, & Poon, 2015).

In the following, we delve into the concept of SRL, discussing its theoretical foundations. Then, we will move on to identifying what design principles can be implemented by teachers to foster students' SRL skills, especially (but not solely) within collaborative learning activities.

1.3.1 *The cognitive and metacognitive component of SRL*

Controlling the cognitive component means consciously selecting strategies to remember information, understand material, solve problems, and evaluate one's learning. For instance, controlling cognitive aspects includes using memorization or self-assessment strategies, such as creating rhymes to remember names or devising methods to verify math problem solutions. In contrast, controlling meta-cognitive aspects involves planning, goal-setting, self-monitoring, and self-evaluating at different stages throughout the acquisition process. The metacognitive component also encompasses reflecting on the learning process and making decisions about it. For example, metacognitive control involves recognizing that one's understanding of a text or lesson is poor and deciding on actions to improve it.

1.3.2 *The motivational and emotional component of SRL*

In terms of motivational processes, self-regulated learners display high self-efficacy, self-attributions (i.e. they can interpret and assign causes to their own successes and failures) and intrinsic interest in what they learn, sustained over time. They are persistent and do not give up easily when they face an obstacle or a failure.

Controlling these aspects involves the ability to effectively manage and regulate emotions while maintaining a sufficient level of cognitive engagement. Both self-efficacy[2] and the ability to manage negative emotions that can hinder learning, such as anxiety or disappointment, are crucial in this regard.

Intrinsic motivation, driven by a genuine interest in the subject matter or the satisfaction of learning itself, is fundamental to

2 Believing in one's capability to accomplish tasks or achieve goals.

SRL. However, extrinsic motivation – motivation stemming from external factors like achieving good grades, obtaining a degree, or avoiding negative outcomes – or even motivational elements introduced through playful approaches like game-based learning or gamification, also play significant roles in SRL (Passarelli et al., 2019).

While self-regulated learners are often motivated by a genuine interest in content or a desire to achieve long-term goals, they also frequently sustain their motivation by making the learning process enjoyable in various ways. For instance, they may study with peers, devise games, or employ strategies to make learning tasks more engaging, especially when their motivation is extrinsic. For example, a medical student may be highly motivated to excel as a doctor, yet s/he may not inherently find memorizing the names of all the bones in the human hand intrinsically interesting, and therefore resort to engaging memorization strategies.

Some scholars (Pintrich, 2000) use the term "goal orientation" to differentiate between different motivational roles within SRL. Motivational goals may include mastering content, completing a course of study and obtaining a qualification, pleasing a teacher or parent, or demonstrating one's abilities in a competitive context.

1.3.3 *The behavioural component of SRL*

From the behavioural point of view, self-regulated learners optimize learning processes by selecting, structuring, and creating environments in order to facilitate their learning. They seek out advice, information, and configure the learning environment in a way that is conducive to learning; they self-instruct during acquisition and self-reinforce during performance (Zimmerman, 1990). They also modulate the effort devoted to learning according to the results of self-assessment. For example, self-regulated

learners are adept at determining when to persist with a task or seek assistance, recognizing when to proceed, take a break, or seek help to avoid discouragement.

In terms of actions taken to optimize the learning environment, these involve removing or minimizing distractions and striving to comprehend the teacher's or learning environment's demands to meet expectations effectively. When technology is involved, configuring the software and its interface to facilitate its use for learning purposes pertains to this component.

1.3.4 *Self-regulated learners in practice*

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).

Research on SRL suggests that it is contingent on context (Boekaerts, 1999): an individual's ability to mobilize learning skills can vary across different contexts depending on factors like motivation and specific conditions. This variability explains why certain learners excel in self-regulating their learning in one domain, but encounter challenges in mastering different subjects. The strategies necessary for effective self-regulation in these distinct disciplines differ significantly, and attempts to apply strategies from one area to another can result in shortcomings.

According to Persico (2022), in conclusion, self-regulated learners know what they want to learn and why; plan in advance their own learning process and adjust their plans when needed; consciously select study, comprehension, and problem-solving strategies, often adapting techniques learned from other domains; are resilient in the face of setbacks, developing methods to manage and overcome negative emotions; continuously monitor their

progress and adjust their strategies as needed to achieve their goals; flexibly modify their original plans by adapting goals, time devoted to tasks, and learning strategies on the basis of previous learning outcomes.

It should be noted that SRL does not concern individual learning only. Self-regulation takes place in collaborative learning environments too and requires a number of additional skills needed to negotiate self-regulatory decisions with peers. This will be tackled in section 4.5 of this chapter.

1.3.5 *A model for Self-Regulated Learning*

Several theoretical models and frameworks have been proposed to represent and explain how SRL takes place (Panadero, 2017). Despite their differences, these frameworks all share some common features: that self-regulated learners have the capacity to monitor and regulate their cognitive and metacognitive, emotional and motivational, and behavioral processes; that they engage in a constructive learning process influenced by both the learning environment and their prior knowledge; that their actions are goal-oriented, involving continuous adjustment of behaviour to achieve desired outcomes; and self-regulatory behaviors play a mediating role in the relationship between students' performance, contextual factors, and individual characteristics (Moos & Ringdal, 2012).

Figure 2 illustrates one of the most well-known of these models: Zimmerman's cyclic model, first introduced in 1998 and subsequently refined by the same author (Zimmerman, 1998; 2002; 2008). According to this model, self-regulated learning (SRL) is a cyclic process comprising three phases: Forethought, Performance, and Self-Reflection. Each phase is essential for the self-regulation process, with the first phase, Forethought, setting the basis for the whole process and the final phase, Self-Reflec-

tion, typically initiating a new Forethought phase. Each new cycle incorporates insights from the previous cycle and its Forethought phase leads to adaptations in strategies to enhance subsequent Performance and Self-Reflection phases. The cycle continues to repeat until the learner decides to stop either due to satisfaction with the result or other reasons.

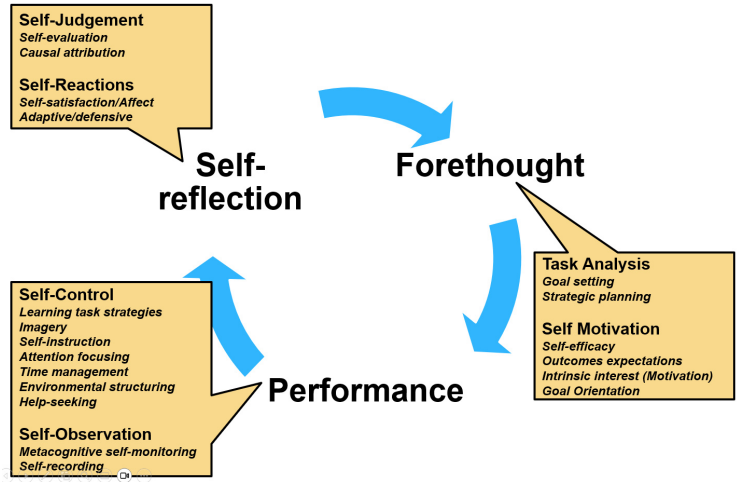

Figure 2. Zimmerman's model of Self-Regulated Learning (Persico, 2022)

Each phase can be further analysed by distinguishing its sub-processes as illustrated in Figure 2. The forethought phase focuses on task analysis and self-motivational beliefs. Task analysis involves setting goals and developing an initial plan for the learning strategies to be used. Self-motivational beliefs include an initial assessment of one's ability to achieve the objectives (self-efficacy) and expected outcomes, as well as evaluating learner motivation and "goal orientation," which determines whether the learner is driven by intrinsic interest in mastering the content or by more competitive motivations.

The performance phase involves self-control and self-observation. Self-control includes monitoring performance, adapting learning strategies when necessary, using imagination or other creative strategies to remember information, managing time, personalizing the learning environment, avoiding distractions, adjusting focus on learning tasks, and making decisions about seeking help. Help-seeking encompasses not only asking for assistance from teachers, experts, or peers but also searching for alternative information sources to enhance understanding or gain deeper knowledge. In the digital age, for example, searching for explanations or more in-depth material online is considered a help-seeking activity. Self-observation includes self-recording (tracking one's learning process) and metacognition, which involves reflecting on, understanding, analysing, and managing one's cognitive processes. Metacognition forms the basis for effectively adapting the learning process.

Finally, the self-reflection phase involves self-judgment and self-reactions. This includes evaluating the learning process, self-evaluation, identifying causes of failure, emotional reactions (positive, such as satisfaction, or negative, such as anger), and recognizing opportunities to adapt ineffective approaches. Adaptation is a critical self-regulated behaviour, contrasting with self-defensive reactions that lead to justifying ineffective strategies rather than improving them.

1.4 Designing for learning to learn

SRL skills have always been important in both formal and informal learning contexts. However, recent decades have witnessed rapid technological advancements that have significantly transformed how we live, work, and learn, with these changes continuing to accelerate. Consequently, the need for lifelong learning has become more pronounced across all professional and social

settings, making SRL skills increasingly vital. Many companies now prioritize SRL skills alongside professional expertise when hiring new employees. The ability to learn new techniques, master new methods and tools, and learn from colleagues is crucial.

Research indicates that SRL skills generally improve with age but do not develop spontaneously. According to Boekaerts (1997), these skills can be promoted or "taught". Other studies suggest that their development occurs through practice (Van den Boom et al., 2004). This might seem paradoxical: to learn these skills, one needs to practice them, but to practice them, one must possess them to some extent. This paradox can be resolved using the "scaffolding and fading" techniques introduced by Brown, Collins, and Duguid in the late 1980s (Brown, Collins & Duguid, 1989; Collins, Brown, & Holum, 1991) within the context of cognitive apprenticeship theory. These techniques involve providing strong initial support from the teacher or tutor, which gradually fades to encourage learner independence. For SRL, this means teachers should initially offer explicit guidance to help students make informed decisions about their learning. Over time, teachers should gradually decrease their guidance and offer opportunities for choices, thus increasing the learners' autonomy and responsibility, considering their initial abilities and educational level.

When discussing SRL in the school context, we should bear in mind that students (and sometimes even teachers) are not completely free to choose what, when and how to learn, because usually the educational goals and content are defined at policy level for each educational institution. However, teachers can and should make sure that students gradually take responsibility of their learning through the above mentioned scaffolding and fading processes. According to Hadwin and colleagues (Hadwin, Järvelä, & Miller, 2017), we should refer to learning processes where two or more individuals share the regulation of learning processes as co-regulated learning. Co-regulation typically involves guid-

ance, feedback, and modelling of strategies. Over time, the learner gradually takes more responsibility for their learning as they develop self-regulation skills. This collaborative dynamic helps learners acquire effective strategies and build confidence in their abilities.

Several studies concern how a LD can foster the development of SRL skills in learners (Dettori & Persico, 2011; Paris & Paris, 2001). Based on the previous discussion, the first general recommendation is to provide opportunities for SRL practice by allowing some degree of freedom for learners to create their own personal learning paths. A second guideline is to support SRL through scaffolding and fading, building upon learners' previous experience and knowledge. So, for example, if the training is conducted in a new or unfamiliar format (such as when learners are engaged in online learning and they are new to it), it is essential to clearly explain the training method, the tools to be used, the available support personnel, how to contact them, and what is expected from the learner. Initially, dedicating time to familiarize participants with the learning environment and with each other can be beneficial. A third recommendation is to design and equip the learning environment (whether virtual or physical) with tools that facilitate SRL practice and skill development. A classroom set up only for passive listening, or an online environment that offers no choices and does not highlight any alternative paths is unlikely to support SRL practice effectively.

In the following we consider these features, distinguishing between what can be done to support each of the Zimmerman's model phases.

1.4.1 *Designing the Forethought phase*

Let's begin by analysing what can be done to facilitate the forethought phase. During this stage, actions to support SRL devel-

opment should activate prior knowledge and metacognitive skills, as well as provide learners with the opportunity to participate in defining the goals. This entails illustrating the general aims and the reasons why they are important, checking their self-efficacy beliefs and outcomes expectations, jointly planning the learning process, and considering students' preferences and aptitudes. This includes allowing learners to make choices about objectives, content, methods, learning paths, assessment (Ellis & Folley, 2011), and organization of work (such as configuring the environment, defining time, and selecting learning groups).

For example, encouraging learners to recall or articulate what they already know about the topic can help them establish their initial position relative to the content domain and define their personal goals, becoming aware of their goal orientation. Additionally, if the content allows, it is beneficial to permit the personalization of objectives, the selection of learning strategies and materials (audio, video, or text), and the choice of themes to practice on, using examples already familiar to the learner.

1.4.2 *Designing the Performance phase*

To effectively support SRL during the performance phase, it is essential to provide opportunities for monitoring progress along the learning journey, managing time, continuously assessing outcomes, and enhancing performance through assistance or constructive feedback when necessary. Controlling the learning environment is also critical. In physical environments, learning designers should ensure a setting where learners can choose and switch between different modes of work (for example, group work vs individual study). This might include making quiet spaces available for individual study or suitably-arranged areas for collaborative work. Ideally, each individual should have the ability to personalize their environment. Virtual environments, as dis-

cussed in the following chapter, typically offer greater flexibility in achieving this compared to physical settings.

1.4.3 *Designing the Self-Reflection phase*

In this phase, it is crucial to provide opportunities for students to assess their own learning progress and become attuned to (and possibly even control) their emotional responses to both success and failure.

Regarding assessment methods, Ellis & Folley (2011) advocate the need to offer students significant autonomy, allowing them to choose the format (such as the type of artefacts they should produce), content (the topics or problems to tackle with the subject matter), and timing (the deadlines). They even suggest that assessment criteria and outcomes should be negotiated between teacher and student. Formative assessment, now often referred to as assessment for learning, plays a pivotal role in SRL because it empowers students to make informed decisions about how to improve their learning based on comprehensive feedback (Nicol & Macfarlane-Dick, 2006).

To facilitate self-assessment and performance monitoring, activities can be designed where students compare their work against desired outcomes. Peer-review practices are particularly beneficial in this regard, as they not only provide feedback but also allow students to observe how their peers approach and resolve challenges, thereby inspiring improvements in their own work (Nicol, Thomson, & Breslin, 2014). Comparing with peers rather than experts not only supports sustainable assessment practices, especially in large groups, but also reduces instances of discouragement or negative self-reactions.

In the self-reflection phase, it is essential for the learning designer to ensure that students correctly attribute the causes of both failures and successes. This attribution is crucial as it informs sub-

sequent planning in the forethought phase of the self-regulation cycle and effectively triggers further actions. For example, when students attribute the causes of failure to factors that cannot be changed (i.e. "lack of intelligence"), it is unlikely that they will effectively cope with further attempts to learn. When the causes are modifiable (i.e. the task was too difficult, I need to try something easier"), further efforts are more likely to succeed.

1.4.4 *Self-Regulated Learning in online environments*

This section delves into the complex relationship between technologies and SRL. Drawing on existing literature, we propose practical applications of the design principles outlined in the previous section for designing online learning environments.

For several decades, SRL has been a focus of numerous researchers, particularly educational psychologists, who have primarily approached it from a theoretical standpoint (Boekaerts, Pintrich, & Zeidner, 2000; Shunk & Zimmerman, 1998; Zimmerman & Shunk, 2001; Panadero, 2017). SRL encompasses concepts from educational psychology and learning science. As already mentioned, with the rapid advancement of information and communication technologies, the way individuals learn and strategize has dramatically evolved. Online learning environments play an ambivalent role in SRL: they can challenge learners (e.g., through cognitive overload and disorientation due to the richness and lack of organization of online information) or provide tools and functionalities that enhance SRL practice. Consequently, numerous studies have explored the potential of technologies for SRL and the conditions needed to fully harness this potential (Bartolomé, Bergamin, Persico, Steffens, & Underwood, 2011; Carneiro, Lefrere, Steffens, & Underwood, 2012; Persico & Steffens, 2017; Dettori & Persico, 2011; Dever et al., 2024).

Given the diversity of online environments, it is impossible to

make generalizations that apply to all of them. Instead, many studies focus on specific types of online systems/platforms and their potential and requirements for SRL. For example, Azevedo (2005) explored the use of hypermedia systems as metacognitive tools, Littlejohn and colleagues examined SRL in MOOCs (Littlejohn, Hood, Milligan, & Mustain, 2016), and Dever and colleagues (Dever at al., 2024) investigated SRL in relation to Intelligent Tutoring Systems.

Different learning environments can be configured and used in various ways, so it is crucial to recognize that even the best-designed online system/platform can be ineffective if not used appropriately by teachers or learners.

Among the powerful affordances for SRL of online learning environments, personalization features stand out. Dabbagh and Kitsantas (2004) note that technologies, particularly "student-centered" personalized learning environments, can shift control from teachers to learners, encouraging learners to take responsibility of their learning. These environments naturally foster the virtuous (or perhaps vicious?) cycle between SRL practice and skill development discussed earlier (Fig. 3). While Dabbagh and Kitsantas refer to these as Personal Learning Environments, other authors prefer the term Learning Ecologies (LE) (Peters & Romero, 2019). Regardless of terminology, personalized learning – where learners make personal choices about their learning process – is central to SRL.

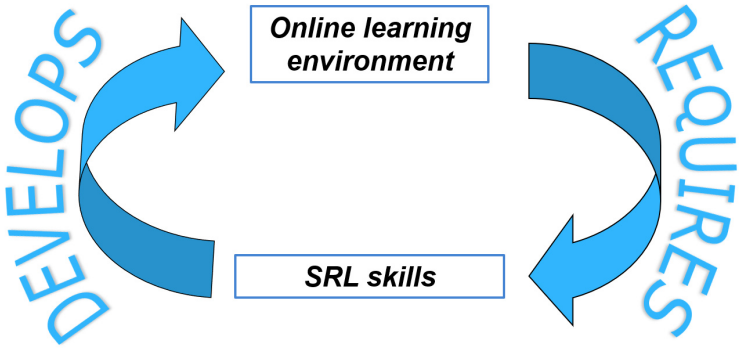

Figure 3. The vicious/virtuous circle of the development of SRL skills in online environments (adapted from Persico, 2022)

On one hand, online systems are virtual or hybrid environments that offer learners opportunities to practice SRL skills, thereby fostering their development. Learners are responsible for deciding how and whether to utilize the affordances provided. This means they control the timing, methods, interlocutors, pace, and other aspects of their learning. When the learning environment is open and flexible, students can build, equip, and configure their own technology-enhanced learning ecosystem. Consequently, there are ample opportunities to practice SRL, and hence develop SRL skills. However, if learners are not yet capable of self-regulation, they may struggle in an unfamiliar environment where they feel out of control. Therefore, practices related to self-regulation – such as goal setting, self-monitoring, self-evaluation, task strategy selection, help-seeking, time planning, and time management – should be facilitated in online environments.

A typical approach is to offer help and tools that guide learners and provide useful affordances, such as calendars for planning study sessions and reminding of deadlines, discussion forums for seeking help, ePortfolios for uploading and viewing peers' artifacts for inspiration, and badges or other rewards to track achievements

(Cucchiara, Giglio, Persico, Raffaghelli, 2014). Without such supports, learners with poor SRL skills risk getting "shipwrecked" and lost in a sea of content and tools. Thus, it is crucial to consider the initial capabilities of students before deciding on the type of environment to provide.

1.4.5 *Self-Regulated Learning in online collaborative contexts*

Online learning contexts are environments inspired by socio-constructivist theories, where learning occurs through online peer collaboration aimed at creating common artifacts, sharing practices and experiences, and learning together. In these contexts, communication and negotiation of meanings drive the learning process. Studies on SRL in Computer Supported Collaborative Learning (CSCL) indicate that online collaborative learning demands specific SRL skills, as learners must negotiate not only the content to be learned, but also various aspects of the learning process with community members (Dettori, Giannetti & Persico, 2006; Hadwin, Järvelä, & Miller, 2017).

On one hand, practicing self-regulation in virtual communities might be easier than in other learning environments, as they inherently require active engagement in the learning process, involve help-seeking as a core part of socio-constructivist learning dynamics, and rely on written interactions that support reflection and tracking of the learning process. On the other hand, the need to balance individual autonomy with group needs adds complexity. In online collaborative learning, decisions about the learning process must be negotiated with other community members.

Consequently, the three phases of Zimmerman's SRL cycle are carried out collaboratively, with objectives, timing, learning strategies, media, and other decisions agreed upon by the community (Delfino & Persico, 2007). Moreover, the emotional aspect of SRL involves both individual and group emotions, with

individual emotions likely influenced by those expressed by the group. Thus, self-regulation in these contexts still requires specific skills, particularly social ones.

Early studies on self-regulation in CSCL (Dettori & Persico, 2007; Delfino, Dettori, Persico, 2008) based on Zimmerman's model adjusted it to include not only the three phases and components (cognitive/metacognitive, emotional/motivational, and behavioral) but also an additional "individual vs. social dimension", which is crucial in online communities.

These studies underscored the importance of the social component of self-regulation in online learning contexts and revealed the need to balance individual self-regulated choices with those of other community members. This balancing act leads to the adoption of self-regulatory strategies specific to these contexts. In essence, it is the community that regulates itself, making collective decisions on deadlines, methods, objectives, and content. Therefore, designing activities or paths for online collaborative learning must consider these dynamics, the time they require, and the necessity of supporting these competencies through scaffolding and fading techniques. Especially for participants new to this mode of learning, it is essential to facilitate communication and support collaboration with appropriate techniques (Pozzi & Persico, 2011), create spaces for socialization and meta-reflection, and address emotional aspects.

More recent studies about SRL in socio-constructivist learning propose to adopt the term Socially Shared regulation of Learning (SSRL) (Hadwin & Oshige, 2011). Hadwin, Järvelä, & Miller, 2017). In SSRL, all members of the group contribute to setting goals, planning, monitoring progress, and reflecting on outcomes. This collaborative approach relies on group cohesion, communication, and shared responsibility. Members work together to negotiate strategies, support each other, and ensure that the group's learning objectives are met. SSRL emphasizes the collective cognitive and metacognitive processes within the group. Studies in

this field reveal that related skills develop through practice in CSCL environments and that facilitators play a critical role in developing SSRL skills by providing scaffolding collaborative dynamics. Like in SRL, this support can gradually be removed as learners become more competent at regulating their own and their peers' learning. While in terms of outcomes SSRL enhances understanding and improves performance, there are challenges and barriers of SSRL. First, online communities need to coordinate efforts and resolve conflicts by developing strategies for managing disagreements and ensuring equitable participation. Second, while diversity can enrich the learning experience, reaching consensus may turn out to be difficult and lead community members to accept sub-optimal outcomes (Panadero & Jarvela, 2015).

1.4.6 *A rubric to assess the potential of a design to support SRL*

In this section, we present a rubric of criteria to assess the potential of a design (Table 1) to support SRL, especially (but not exclusively) within online collaborative learning activities.

The rubric is meant to be used in a formative way: by going through the prompts the teacher can check if a design satisfies the related criterion and possibly amend the design by including ways to meet the criterion. For example, if the design does not include a phase where learning aims are shared and negotiated by the teacher with the students (First prompt of the Forethought phase), this can be added to make sure learners appropriate the aims.

In table Y, the first column contains the prompt identification code, whereas the second column contains a keyword that indicates the aim of the related prompt. Although the table is structured according to the three phases of Zimmerman's model of self-regulation, it should be noted that the keywords reported in

column 2 refer to activities (like goal setting) or constructs (like motivation) that are relevant across the three different phases. For instance, consider time management. During the forethought phase, learners initially determine how much time to allocate to specific activities based on their commitments and estimated learning needs (possibly supported by course-provided estimates). In the performance phase, self-regulated learners monitor and try to adhere to their planned schedule. In the self-reflection phase, any significant deviations prompt a reassessment of time allocation. To successfully manage time, tools such as watches, calendars, and course outlines can serve the purpose of managing time in all SRL phases, —whether in physical or virtual environments. Their utilisation and objectives may vary to suit each phase's specific demands: planning deadlines in the forethought phase, monitoring whether they are met in the performance, and adjusting the planning in the self-reflection. Hence, some of the keywords appear under different phases even if each prompt refers uniquely to one phase.

The third column contains the prompts intended to support teachers in assessing if and to what extent the features of a design lends themselves to support SRL practice and, consequently, the development of related skills.

Table 1. Self-Regulated Learning prompts

Forethought (F)		
F1	Goal setting	Learning aims are shared/negotiated with students (e.g., the design starts with a discussion of the aims and their importance).
F2	Strategic planning	How the learning aims will be achieved is shared/negotiated with students (e.g. the design includes a discussion of whether to adopt individual study or collaborative learning, problem based learning, or other approaches).
F3	Goal Orientation	Students' motivation (intrinsic and extrinsic) is leveraged by the design (e.g. the design entails assessing students' interest in the topic).

F4	Self-efficacy beliefs	Students' self-efficacy beliefs, i.e. students' beliefs in their own capacity to achieve the learning goals, are leveraged by the design (e.g. the design includes assessing and discussing students' self-efficacy beliefs or puts all students in a self-assuring position).
F5	Motivation	Students' prior knowledge is activated by the design (i.e. the design requires students to voice their previous knowledge about the topics).
F6	Strategic planning	Students (or groups of students) are encouraged to make "aware" choices as to content. "Aware" here means "optimal for learning" (e.g., the design fosters students not to choose the easiest topics/difficulty levels, but rather those that maximize learning, compatibly with time available and students' skills).
F7	Strategic planning	Students (or groups of students) are encouraged to make "aware" choices as to learning strategies, i.e. choose strategies that best suit the learning objectives (e.g. when the learning objectives include solving problems, memorisation strategies are not optimal, while practicing problem solving is more suited).
F8	Personalisation	Students (or groups of students) are encouraged to make "aware" choices as to how to configure the learning environment (e.g. in digital environments, by personalising the interface; at school, by changing the classroom arrangement, choosing the place/people they want to learn; at home, by creating an atmosphere conducive to learning).
F9	Time management	Students (or groups of students) are encouraged to make "aware" choices as to timing (e.g. discuss deadlines for homework, plan dates of assessment sessions).
F10	Personalisation	Students (or groups of students) are encouraged to make "aware" choices as to what communication media and resources should be used (e.g. the design lets students choose according to individual preferences among communication media or resources, for example, allowing non-mother tongue students to use material in their first language).
F11	Personalisation	Students (or groups of students) are encouraged to make "aware" choices in terms of personalization of objectives (i.e. objectives that are challenging, but not too much, for each student).
F12	Supporting orientation	Students (or groups of students) are encouraged to carry out activities or use tools to support orientation (e.g. ice breaking activities or use of orientation/tracking tools)?

Performance (P)		
P1	Strategic planning	Students are encouraged to adapt their learning strategies when the previous ones turn out to be unsuccessful. (e.g. when students fail to memorise terminology in a foreign language just by reading & repeating it, they might need more specific memorisation strategies, perhaps based on flash cards).
P2	Strategic planning	Students are fostered to choose different learning strategies according to what they are learning (e.g. for foreign languages, rehearsing and practicing listening comprehensions are effective strategies, while for mathematics problem solving and drills and practice strategies are usually more suited).
P3	Motivation	Student motivation (intrinsic and extrinsic) is supported throughout the learning activity (e.g. through playful learning approaches).
P4	Meta-cognition	Students are encouraged to practise meta-cognition (i.e. reflection on their own learning process) or use meta-cognitive tools (e.g. content maps or road maps, meta-cognitive discussion forums).
P5	Help seeking	Students are encouraged to seek help (from experts, peers or external sources) in a self-regulated manner (e.g., in problem solving, not too early, without even having tried, but also not too late, to avoid discouragement).
P6	Time management	Students (or groups of students) are encouraged to control time, possibly using tools for time management (calendars, deadline reminders).
P7	Personalisation	Students (or groups of students) are encouraged to make decisions as to what kind of artefacts they wish to produce in terms of type of media or content (e.g. students can choose to produce a graphic artefact, something tangible, or a presentation and go deep into a specific topic).
P8	Help seeking	Students (or groups of students) are encouraged to search for additional learning material, based on their learning preferences (e.g. proficient students are encouraged to look for more in-depth material, non-native language speakers are encouraged to search for material in their language).
P9	Attention focusing	Students are encouraged to make choices aimed at avoiding distractions (i.e. silencing cell phones, avoiding noisy places when doing homework).
P10	Emotional support	Students (or groups of students) are supported from an emotional/motivational point of view during the learning process (e.g., reciprocal support by peers, teacher's support, parental support).

P11	Emotional support	Students are helped to reflect on control their negative emotions, such as anxiety or disappointment (e.g. constructive feedback is preferred to grades).
Self-reflection (S)		
S1	Self-assessment	Students are encouraged to compare their performance with that of peers, or with benchmarks (e.g. in peer review students learn not only through the feedback they receive but also by comparing their performance with that of peers).
S2	Self-assessment	Students are encouraged to monitor achievement of learning objectives (e.g. through self-assessment tools).
S3	Causal attribution	Students are encouraged to reflect on the causes of their failures (e.g. by identifying the unsuccessful learning strategies, rather than attributing failure to causes that cannot be changed).
S4	Meta-cognition	Students (or groups of students) are involved in defining assessment rubrics (e.g. by deciding which aspects of their learning behaviour will be evaluated and how).
S5	Self-assessment	Students (or groups of students) are involved in defining assessment methods (e.g. by discussing with teachers the way they will be assessed).
S6	Emotional support	Students are involved in self-reflection activities on their own emotional reactions to success or failure (e.g. seizing the opportunity of a student's overreacting after a bad mark, the teacher invites all students to reflect on their emotional reactions).

1.5 Concluding remarks

To conclude, the importance of designing for learning is crucial if teachers want to propose effective learning activities (being them face-to-face or online), as they need to take into due consideration all the variables at play. In this sense, the research field of "LD" is proposing conceptual and technological tools to support the creation, share and re-use of effective designs by communities of teachers, in the attempt to respond to the challenges that the school system is currently facing.

Especially when collaborative learning activities come into play, teachers need to conceptualize the Task, Teams, Time and Technologies to propose meaningful activities for their students.

At the same time, the importance of SRL (and SSRL) cannot be overstated. Teachers play a pivotal role in fostering the development of related skills. By integrating strategies that foster the practice of these skills in their LD and their teaching practices, they can empower students to take control of their learning.

Fostering the development of SRL skills requires:

- Explicit encouragement of SRL use, particularly at the beginning, until students adopt these practices spontaneously.
- Equipping the learning environment with tools that facilitate decision-making and control, such as content maps, time management tools, planning tools, and self-assessment tools.

For teachers, the critical aspects include:

- Finding the right balance between teacher control and student control at each educational level.
- Providing opportunities for choice and encouraging students to make "wise" choices that maximize learning rather than minimizing effort. This principle demands extra effort from the teacher, as it involves creating different types of material and designing alternative learning paths for the same objectives. Therefore, designing for SRL is more complex than designing a one-size-fits-all course.
- Encouraging students to build and rely on their own personal learning environments, fostering autonomy in cognitive and metacognitive tasks, and enhancing their ability to seek help when needed.
- Prioritizing formative assessment over summative assessment and involving students in deciding how and when assessment takes place.

Technologies, particularly socio-constructivist and learner-cen-

tered learning environments, can significantly help address these critical issues. However, they can also hinder learning if they add complexity to information retrieval and interpretation, provide premature answers to problems better solved through discovery, or are used by students to save time or effort rather than maximize learning. One of the major challenges teachers face with technology is ensuring students use it not only to learn but also to manage and control their own learning. Despite the effort required, the long-term benefits make it worthwhile.

References

An, Y. J., & Reigeluth, C. (2011). Creating technology-enhanced, learner-centered classrooms: K–12 teachers' beliefs, perceptions, barriers, and support needs. *Journal of Digital Learning in Teacher Education*, *28*(2): 54-62.

Azevedo, R. (2005). Using hypermedia as a metacognitive tool for enhancing student learning? The role of self-regulated learning. *Educational Psychologist*, *40*(4): 199-209.

Azevedo, R., & Aleven, V. (2013). Metacognition and learning technologies: An overview of current interdisciplinary research. In R. Azevedo, V. Aleven (Eds.), *International handbook of metacognition and learning technologies* (Vol. 28). New York: Springer International Handbooks of Education https://doi.org/10.1007/978-1-4419-5546-3_1.

Azevedo, R., Feyzi-Behnagh, R., Duffy, M., Harley, J., & Trevors, G. (2012). Metacognition and self-regulated learning in student-centered learning environments. In D. Jonassen & S. Land (Eds.), *Theoretical foundations of learning environments* (pp. 171-197). New York: Routledge.

Azevedo R., ‹ Hadwin A.F. (2005). Scaffolding self-regulated learning and metacognition – implications for the design of computer-based scaffolds. *Instructional Science, 33*: 367– 379.

Bandura, A. (1994). Self-efficacy. In V. S. Ramachaudran (Ed.), *Encyclopedia of human behavior* (Vol. 4, pp. 71-81). New York: Academic Press.

Barron, B. (2006). Interest and self-sustained learning as catalysts of development: A learning ecology perspective. *Human Development, 49*(4): 193–224. https://doi.org/10.1159/000094368.

Bartolomé, A., Bergamin, P., Persico, D., Steffens, K., & Underwood, J. (Eds.). (2011). *Self-regulated Learning in Technology Enhanced Learning Environments: Problems and Promises*. Aachen, Germany: Shaker Verlag.

Boekaerts M., & Corno L. (2005). Self-regulation in the classroom: A perspective on assessment and intervention. *Applied Psychology: An International Review*, *54*: 199-231.

Boekaerts, M. (1997). Self-regulated learning: a new concept embraced by researchers, policy makers, educators, teachers and students. *Learning and Instruction*, *7*(2): 161-186.

Boekaerts, M. (1999). Self-regulated learning: where we are today. *International Journal of Educational Research*, *31*: 445-457.

Boekaerts, M., Pintrich, P. R., & Zeidner, M. (Eds.) (2000). *Handbook of self-regulation*. Elsevier.

Broadbent, J., & Poon, W. L. (2015). Self-regulated learning strategies & academic achievement in online higher education learning environments: A systematic review. *The Internet and Higher Education*, *27*: 1-13.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational researcher*, *18*(1): 32-42.

Bruner, J. S. (2009). *The process of education*. Harvard: Harvard University Press.

Carneiro, R., Lefrere, P., Steffens, K., & Underwood, J. (2012). *Self-regulated learning in technology enhanced learning environments: A European perspective* (Technology Enhanced Learning Series, Vol. 5). Rotterdam: Sense Publishers.

Collins, A., Brown, J. S., & Holum, A. (1991). Cognitive apprenticeship: Making thinking visible. *American educator*, *15*(3): 6-11.

Conole, (2010). Learning design – Making practice explicit. In *ConnectEd 2010: 2nd International conference on Design Education*, 28 June - 1 July 2010, Sydney, Australia.

Conole, G. (2013). *Designing for learning in an open world*. New York: Springer.

Cucchiara, S., Giglio, A., Persico, D., & Raffaghelli, J.E. (2014). Supporting Self-regulated Learning through Digital Badges: a Case

Study. In Yiwei Cao, Terje Väljataga, Jeff K.T. Tang, Howard Leung, Mart Laanpere (Eds.), *New Horizons in Web Based Learning, Revised selected papers of the 13th International Conference on Web- based learning (ICWL2014)* (pp.133-142). LNCS 8699, Cham: Springer. https://doi.org/10.1007/978-3-319-13296-9.

Dabbagh, N., & Kitsantas, A. (2004). Supporting self-regulation in student-centered web-based learning environments. *International Journal on E-learning*, *3*(1): 40-47.

Dabbagh, N., & Kitsantas, A. (2012). Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. *The Internet and higher education*, *15*(1): 3-8.

Delfino, M., & Persico, D. (2007). Designing and running online collaborative courses that support SRL development. In J. Beishuizen, R. Carneiro, & K. Steffens (Eds.), *Self-regulated learning in technology- enhanced learning environments: Individual learning and communities of learners* (pp. 26-39). Aachen, Germany: Shaker-Verlag.

Delfino, M., Dettori, G., & Persico, D. (2008). Self-regulated learning in virtual communities. *Technology, Pedagogy and Education, 17:* 195-205. https://doi.org/10.1080/14759390802383785.

Delfino, M., Dettori, G., & Persico, D. (2010). An online course fostering self-regulation of trainee teachers. *Psicothema*, *22*: 299-305.

Dettori, G., Giannetti, T., & Persico, D. (2006). SRL in Online Cooperative Learning: Implications for Pre-Service Teacher Training. *European Journal of Education*, *41*: 397-414. https://doi.org/10.1111/j.1465-3435.2006.00273.x.

Dettori, G., & Persico, D. (2007). Indicators of Self-Regulation in Computer Supported Collaborative Learning. In H. Uzunboylu & N. Cavus (Eds.), *Proceedings of the International Educational Technology Conference 2007,* vol. II (pp. 148-153). Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=ED500177&site=ehost-live.

Dettori, G., & Persico, D. (2008). Detecting Self-Regulated Learning in Online Communities by Means of Interaction Analysis. *IEEE Transactions On Learning Technologies*, *1*: 11-19. https://doi.org/-10.1109/TLT.2008.7.

Dettori, G., & Persico, D. (Eds.). (2011). *Fostering Self-Regulated Learn-*

ing through ICT. Hershey, PA: IGI Global. https://doi.org/10.4018/978-1-61692-901-5.

Dever, D. A., Wiedbusch, M. D., & Azevedo, R. (2024). Analytical Approaches for Examining Learners' Emerging Self-regulated Learning Complex Behaviors with an Intelligent Tutoring System. In *International Conference on Human-Computer Interaction* (pp. 116-129). Cham: Springer Nature Switzerland.

Dignath-van Ewijk, C., Dickhäuser, O., & Büttner, G. (2013). Assessing how teachers enhance self-regulated learning: A multiperspective approach. *Journal of Cognitive Education and Psychology*, *12*(3): 338-358.

Dignath, C., & Mevarech, Z. (2021). Introduction to special issue mind the gap between research and practice in the area of teachers' support of metacognition and SRL. *Metacognition and Learning*, *16*(3): 517-521.

Dignath-van Ewijk, C., & Van der Werf, G. (2012). What teachers think about self-regulated learning: An investigation of teacher beliefs about enhancing students' self-regulation and how they predict teacher behavior. *Education Research International*, 1–10.

Dobozy, E. (2011). Typologies of learning design and the introduction of a "LD-Type 2" case example'. *eLearning Papers, 27*(27): 1-11.

Earp, J., Ott, M., & Pozzi, F. (2013). Facilitating Educators' Knowledge Transfer with Information Systems for Sharing Practices. *Computers in Human Behaviour, 29:* 445–455.

Edisherashvili, N., Saks, K., Pedaste, M., & Leijen, Ä. (2021). Supporting Self-Regulated Learning in Distance Learning Contexts at Higher Education Level: Systematic Literature Review. *Frontiers in psychology*, *12*: 792422-792422. https://doi.org/10.3389/fpsyg.2021.792422.

EDUCAUSE Learning Initiative (2009). *The seven things you should know about …Personal Learning Environments*. Retrieved from https://net.educause.edu/ir/library/pdf/ELI7049.pdf

Ellis, C., & Folley, S. (2011). Using student assessment choice and e-assessment to achieve Self-Regulated Learning. In G. Dettori & D. Persico (eds.), *Fostering Self-Regulated Learning Through ICT* (pp. 89-104). Information Science Reference.

English, M. C., & Kitsantas, A. (2013). Supporting student self-regu-

lated learning in problem-and project-based learning. *Interdisciplinary Journal of Problem-based Learning*, *7*(2): 128-150. 26.

EU Council. (2002). Council Resolution of 27 June 2002 on Lifelong Learning. *Official Journal of the European Communities*, July 9, 2002.

Greene, J. A. (2021). Teacher support for metacognition and self-regulated learning: a compelling story and a prototypical model. *Metacognition and Learning*, *16*(3): 651-666.

Gustafson, K. L., & Branch, R. M. (2002). What is instructional design? In R. A. Reiser, & J.V. Dempsey (eds.), *Trends and Issues in Instructional Design and Technology* (pp. 17-25). Columbus: OH, Merrill Prentice Hall.

Hadwin, A., Järvelä, S., & Miller, M. (2017). Self-regulation, co-regulation, and shared regulation in collaborative learning environments. In *Handbook of self-regulation of learning and performance* (pp. 83-106). Routledge.

Hadwin, A., & Oshige, M. (2011). Self-regulation, coregulation, and socially shared regulation: Exploring perspectives of social in self-regulated learning theory. *Teachers College Record*, 113(2): 240-264.

Järvelä, S., & Järvenoja, H. (2011). Socially constructed self-regulated learning and motivation regulation in collaborative learning groups. *Teachers College Record*, *113*(2): 350-374.

Koper, R., & Manderveld, J. (2004). Educational modelling language: modelling reusable, interoperable, rich and personalised units of learning. *British Journal of Educational Technology, 35* (5): 537-552.

Lakkala, M. (2007). The Pedagogical Design of Technology Enhanced Collaborative Learning. *E-Learning Europe*. Retrieved from https://www.researchgate.net/publication/241900666_The_pedagogical_design_of_technology_enhanced_collaborative_learning

Laurillard, D. (2012). *Teaching as a Design Science: Building Pedagogical Patterns for Learning and Technology*. New York: Routledge.

Lee, E., & Hannafin, M. J. (2016). A design framework for enhancing engagement in student-centered learning: Own it, learn it, and share it. *Educational Technology Research and Development*, 64(4): 707-734.

Littlejohn, A., Hood, N., Milligan, C., Mustain, P. (2016). Learning in MOOCs: Motivations and self-regulated learning in MOOCs. *The Internet and Higher Education*, *29*: 40-48.

Littlejohn, A., Milligan, C., & Margaryan, A. (2012). Charting collective knowledge: Supporting self-regulated learning in the workplace. *Journal of Workplace Learning*, *24*(3): 226-238.

Loyens, S. M., Magda, J., & Rikers, R. M. (2008). Self-directed learning in problem-based learning and its relationships with self-regulated learning. *Educational Psychology Review*, *20*(4): 411-427.

Maina, M. F., & González, I. G. (2016). Articulating personal pedagogies through learning ecologies. In *The future of ubiquitous learning* (pp. 73-94). Berlin, Heidelberg: Springer.

Manganello, F., Pozzi, F., Passarelli, M., Persico, D., & Dagnino, F. M. (2021). A dashboard to monitor Self-Regulated Learning behaviours in online professional development. *International Journal of Distance Education Technologies (IJDET)*, *19*(1): 18-34.

Martinez, M. E. (2006). What is metacognition?. *Phi delta kappan*, *87*(9): 696-699.

Mega, C., Ronconi, L., & De Beni, R. (2014). What makes a good student? How emotions, self-regulated learning, and motivation contribute to academic achievement. *Journal of educational psychology*, *106*(1): 121-131.

Milligan, C., Littlejohn, A., & Margaryan, A. (2014). Workplace Learning in Informal Networks. *Journal of Interactive Media in Education*, *06*: 1-11.

Molenda, M. (2003). *In search of the elusive ADDIE Model, Performance Improvement*, Retrieved from https://onlinelibrary.wiley.com/doi/-epdf/10.1002/pfi.4930420508

Moos, D. C., & Ringdal, A. (2012). Self-regulated learning in the classroom: A literature review on the teacher's role. *Education Research International*, *2012*: 1-15.

Mor, Y., & Craft, B. (2012). Learning design: reflections upon the current landscape. *Research in Learning Technology - Supplement: ALT-C 2012 Conference Proceedings*, *20:* 85-94.

Mor, Y., & Mogilevsky, O. (2013). The learning design studio: collaborative design inquiry as teachers' professional development. *Research in Learning Technology, 21*.

Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in higher education*, *31*(2): 199-218.

Nicol, D., Thomson, A., & Breslin, C. (2014). Rethinking feedback

practices in higher education: A peer review perspective. *Assessment and Evaluation in Higher Education*, *39*(1): 102-122 https://doi.org/-10.1080/02602938.2013.795518.

National Research Council (NRC) (2012). *A framework for K–12 science education: Practices, crosscutting concepts, and core ideas*. Washington, DC: National Academies Press.

OECD (2018). *The future of education and skills: Education 2030, the future we want*. Retrieved from https://www.oecd.org/education/-2030/E2030%20Position%20Paper%20(05.04.2018).pdf

Panadero, E (2017). A Review of Self-regulated Learning: Six Models and Four Directions for Research. *Frontiers in Psychology*, *8*: 422. https://doi.org/10.3389/fpsyg.2017.00422.

Panadero, E., & Järvelä, S. (2015). Socially shared regulation of learning: A review. *European Psychologist, 20(3).* https://doi.org/10.1027/1016-9040/a000226

Paris, S. G., & Paris, A. H. (2001). Classroom applications of research on self-regulated learning. *Educational psychologist*, *36*(2): 89-101.

Passarelli, M., Dagnino, F.M., Earp, J., Manganello, F., Persico, D., Pozzi, F., Bailey, C., Perrotta, C., Buijtenweg, T., & Haggis, M. (2019). Educational Games as a Motivational Tool: Considerations on their Potential and Limitations. In H. Lane, S. Zvacek & J. Uhomoibhi (Eds.) *Proceedings of the 11th International Conference on Computer Supported Education (CSEDU 2019)* (pp.330-337). Scitepress. https://doi.org/10.5220/0007586503300337.

Pérez-Álvarez, R., Maldonado-Mahauad, J., & Pérez-Sanagustín, M. (2018). Tools to support self-regulated learning in online environments: Literature review. In V. Pammer-Schindler et al. (Eds.), *European conference on technology enhanced learning ECTEL 2018* (pp. 16-30). LNCS 11082, Dordrecht: Springer. https://doi.org/-10.1007/978-3-319-98572-5_2.

Persico, D. (1997). Methodological constants in courseware design. *British Journal of Educational Technology*, 28(2): 111-124.

Persico, D. (2022). *A guide for teachers on self-regulated learning in Technology Enhanced Learning Environments*. Roma: CNR Edizioni. http://doi.org/10.17471/54017

Persico, D., Milligan, C., & Littlejohn, A. (2015). The Interplay Between Self-Regulated Professional Learning and Teachers' Work-

Practice. *Procedia - Social and Behavioral Sciences*, *191*: 2481-2486 https://doi.org/10.1016/j.sbspro.2015.04.590.

Persico, D., Passarelli, M., Pozzi, F., Earp, J., Dagnino, F. M., & Manganello, F. (2019). Meeting players where they are: Digital games and learning ecologies. *British Journal of Educational Technology*, *50*(4): 1687-1712.

Persico, D., & Pozzi, F. (2015). Informing learning design with learning analytics to improve teacher inquiry. *British Journal of Educational Technology*, *46*(2): 230–248. https://doi.org/10.1111/bjet.12207.

Persico D., Pozzi F., Anastopoulou S., Conole G., Craft B., Dimitriadis Y., Hernández-Leo D., Kali Y., Mor Y., Pérez-Sanagustín M., & Walmsley H. (2013). Learning design Rashomon I - supporting the design of one lesson through different approaches. *Research in Learning Technology, 21*. https://doi.org/10.3402/rlt.v21i0.20224.

Persico, D., & Steffens, K. (2017). Self-regulated learning in technology enhanced learning environments. In E. Duval, M. Sharples, R. Sutherland (Eds.). *Technology enhanced learning* (pp. 115-126). Cham: Springer.

Peters, M., & Romero, M. (2019). Lifelong learning ecologies in online higher education: Students' engagement in the continuum between formal and informal learning. *British Journal of Educational Technology*, *50*(4): 1729-1743.

Pilling-Cormick, J., & Garrison, R. (2007). Self-Directed and Self-Regulated Learning: Conceptual Links. *Canadian Journal of University Continuing Education*, *33*(2): 13-33.

Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of Self-Regulation* (pp. 452–502). San Diego, CA: Academic Press.

Pozzi, F., Asensio-Perez, J. I., Ceregini, A., Dagnino, F. M., Dimitriadis, Y., & Earp, J. (2020). Supporting and representing Learning Design with digital tools: in between guidance and flexibility. *Technology, Pedagogy and Education*, *29*(1): 109–128 https://doi.org/10.1080/-1475939X.2020.1714708.

Pozzi, F., Ceregini, A., Dagnino, F, Ott, M., & Tavella, M (2015). Closing the "Learning Design Life-Cycle" with the Pedagogical Planner. *Best of EDEN 2015 - Open Classroom Conference*, Aalborg.

Pozzi, F., & Persico, D. (2011). *Techniques for Fostering Collaboration in Online Learning Communities: Theoretical and Practical Perspectives*. Hershey, PA: IGI Global - Information Science Reference. https://doi.org/10.4018/978-1-61692-898-8.

Pozzi F., & Persico D. (2013). Sustaining learning design and pedagogical planning in CSCL, *Research in Learning Technology Supplement 2013*, *21*: 20224.

Ranieri, M., & Manca, S. (2013). *Social networks in education. Theoretical bases, application models and guidelines*. Trento: Centro Studi Erickson.

Reiser, R.A. (2001). A History of Instructional Design and Technology: Part II: A History of Instructional Design. *Educational Technology Research and Development*, *49*(2): 57-67.

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary educational psychology*, *25*(1): 54-67.

Saks, K., & Leijen, Ä. (2014). Distinguishing self-directed and self-regulated learning and measuring them in the e-learning context. *Procedia-Social and Behavioral Sciences*, *112*: 190-198.

Schunk, D. H., & Zimmerman, B. J. (Eds.). (1998). *Self-regulated learning: From teaching to self-reflective practice*. New York: Guilford Press.

Schunk, D. H., & Zimmerman, B. J. (Eds.). (2012). *Motivation and self-regulated learning: Theory, research, and applications*. Routledge.

Segaran, M. K., Hasim, Z. (2021). Self-regulated learning through ePortfolio: A meta-analysis. *Malaysian Journal of Learning and Instruction*, *18*(1): 131-156.

Selwyn, N. (2012). Social Media in formal and informal education between potential and reality. *Italian Journal of Educational Technology*, *20*(1): 4-10.

Steffens, K. (2006). Self regulated learning in technology enhanced learning environments: Lessons of a European peer review. *European Journal of Education*, *41*(3 4): 353-379.

Van Den Boom G., Paas F., Van Merrienboer J. J.G., & Van Gog T. (2004). Reflection prompts and tutor feedback in a web-based learning environment: effects on students' self-regulated learning competence. *Computers in Human Behaviour*, *20*: 551-567.

Van Rooij, S. W. (2010). Project management in instructional design: ADDIE is not enough. *British Journal of Educational Technology*, 41(5): 852-864.

Walmsley, H. (2012). Case study: a community of practice for constructivist professional development in elearning. *Innovative Practice in Higher Education*, 1(2).

Wiliam, D. (2011). What is assessment for learning?. *Studies in educational evaluation*, 37(1): 3-14.

Winne, P.H., & Perry, N.E. (2000). Measuring self-regulated learning. In M. Boekaerts, P. Pintrich, & M. Zeidner (Eds). *Handbook of Self-Regulation* (pp. 531–566). Orlando, USA: Academic Press.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational psychologist*, 25(1): 3-17. https://doi.org/10.1207/s15326985ep2501_2.

Zimmerman, B. J. (1998). Developing self-fulfilling cycles of academic regulation: An analysis of exemplary instructional models. In D.H. Shunk, B.J. Zimmerman (Eds.). *Self-Regulated Learning. From Teaching to Self- Reflective Practice* (pp.1-19). Guilford Press.

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice,* 41(2): 64–70.

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal*, 45(1): 166-183.

Zimmerman, B. J. (2015). Self-regulated Learning: Theories, measures, and outcomes. International encyclopedia of the social & behavioral sciences. Elsevier. Retrieved from http://www.sciencedirect.com/-science/article/pii/B9780080970868260601.

Zimmerman, B. J., & Schunk, D. H. (Eds.). (2001). *Self-regulated learning and academic achievement. Theoretical perspectives*. Routledge.

Zimmerman, B. J., Bandura, A., & Martinez-Pons, M. (1992). Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. *American educational research journal*, 29(3): 663-676.

Chapter 2.
Framework design for effective and inclusive Digital and Remote Education[1]

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2.1 The need of guidelines for Learning Design and Self-Regulated Learning

The Covid-19 pandemic highlighted the lack of teachers' competences in Learning Design (LD) for digital settingsand in supporting student's motivation and Self-Regulated Learning (SRL) during online teaching. They were the main hurdles faced by teachers during the emergency education (Giovannella, 2020; Ranieri, 2020). The SuperRED project drew attention to this need, also confirmed by the fact that in the literature there is no framework that integrates the LD fundamentals with the perspectives of SRL to support students' learning processes. With this in mind, the SuperRED framework was conceived as a set of guidelines to

1 Although this chapter has been jointly conceived by the authors, Maria Ranieri wrote paragraphs 2.1, Gabriele Biagini and Alice Roffi worked on paragraph 2.2, Stefano Cuomo on paragraphs 2.3 and 2.5. The paragraph 2.4 which presents the SuperRED framework has been jointly developed by the authors.

assist teachers in implementing effective LD and facilitating students' SRL across several contexts (face-to-face, distance and blended education). In this regard, it aims at equipping educators with the necessary tools and methodologies to adapt teaching and learning to different environments, fostering an inclusive and resilient educational system. Moreover, another crucial aspect was related to the methodology used for its development, which was based on both top-down and bottom-up approaches for guidelines' elaboration, while involving all SuperRED partners (including universities, research institutes and schools). This approach brought the SuperRED team to create more relevant guidelines for teachers' daily needs and practices. From this point of view, the SuperRED framework informed and guided all the project activities, including the conception and implementation of the co-design tools (Chapter 3) as well as the SRL app (Chapter 5).

This chapter illustrates the methodology used to elaborate the SuperRED framework, providing a detailed account of the systematic approach adopted by the consortium throughout the entire process from the ideation to the validation. Firstly, the literature review identified and analysed seminal papers on the main themes of SuperRED project (LD and SRL), while the survey captured teachers' knowledge, experiences, and needs, which were crucial for tailoring the framework to real-world educational practices. After the drafting of the first version of the framework, an international panel of experts was involved to undertake the validation process, aimed at assessing the framework clarity, consistency, and significance. Experts' feedback provided critical insights for refining the framework and enhancing its transferability to the teaching practice.

Focusing on the SuperRED methodology, this chapter documents the rigorous and collaborative effort made by the consortium to create a tool enabling the digital readiness and resilience of educational systems, ultimately enhancing the learning experiences of both teachers and students.

2.2 Framework development

The first major output of the SuperRED project is the SuperRED framework, which – as anticipated – has been developed through an extensive review of the literature and a comprehensive survey aimed at understanding teachers' knowledge, experiences, and needs. Prior to undertaking these research activities, the structure of the framework in terms of characterizing themes was defined and the related perspectives of analysis were identified. As a result, the SuperRED framework is structured around the two main themes:

A. Learning Design
B. Self-Regulated Learning

These themes are explored through three distinct perspectives:

1. Methods/Models: it focuses on the most effective methods and models for supporting LD and SRL in various educational contexts.
2. Tools/Technologies: it examines the tools and technologies that can enhance LD and SRL, ensuring their effectiveness across different learning environments.
3. Learning Ecologies (LE): it considers the broader LE, including the physical and virtual learning environments, that support effective LD and SRL.

Each perspective is further analysed within three different educational contexts: *Remote (Re)*, i.e. the fully online education where students and teachers interact through digital platforms without physical presence, *Blended (Bl)*, i.e. the combination of both face-to-face and online learning experiences, providing a hybrid model that leverages the benefits of both approaches, and

Face-to-face (F2f), i.e. the traditional classroom settings where students and teachers are physically present together (see Figure 1).

		Perspective		
		Methods/Models	**Tools/Technologies**	**Learning Ecologies**
		What are the current knowledge on most effective methods and models to support the learning design and/or self-regulated learning in Re, Bl F2f settings?	What are the current knowledge on most effective tools and technologies to support the learning design and/or self-regulated learning in Re, Bl F2f settings?	What are the current knowledge on learning ecologies aspects to support the learning design and/or self-regulated learning in Re, Bl F2f settings?
Themes	**Learning Design**	**A1**	**A2**	**A3**
	Self-regulated learning	**B1**	**B2**	**B3**

Figure 1: Framework structure

2.2.1 *The literature review*

The literature review was carried out through a collaborative effort among the research partners of the consortium (i.e., University of Florence (UNIFI), the Open University of Catalonia (UOC), the Institute for Educational Technology of the National Research Council (ITD-CNR), and Delft University of Technology (TUDelft)). UNIFI, as the leader of the framework development, coordinated the literature selection and analysis with the support of all partners. This comprehensive process, aimed to draft the first version of the framework, was organized into three main phases:

Phase 1 - Identification of seminal papers: Initially, research partners identified seminal papers on the LD and SRL, which were examined according to three perspectives related to three educational settings. This phase involved the elaboration of a matrix (see Figure 1), where for each element resulting from the in-

tersection of the row for themes and the column for perspectives (e.g., A1, A2, A3 for LD, and B1, B2, B3 for SRL) a detailed literature review was performed to gain a global overview of the state of advancement of the research in the field .

Research partners focused on specific questions to guide their selection: "What are the main recommendations for the most effective methods and models/ tools and technologies/ LE to support LD and/or SRL in remote, blended, and face-to-face settings?

Each partner selected four or five influential papers for each element of the matrix, leveraging their expertise to ensure a comprehensive and well-rounded review. After this initial step, 14 papers were identified for element A1 and 6 were selected; 15 papers were identified for element A2 and 6 were selected; and 5 papers were identified for element A3 with all 5 being selected. For element B1, 11 papers were identified and 6 were selected; for element B2, 13 papers were identified and 6 were selected; and for element B3, 8 papers were identified and 5 were selected.

The selection process ensured that the SuperRED framework was informed by a robust and diverse body of literature, supporting the development of effective and evidence-based guidelines for LD and SRL.

UNIFI was responsible for an early screening, marking five papers as 'Candidate' for inclusion in the analysis and remaining ones as 'Additional' references.

Phase 2 - Refinement of papers' selection for analysis: To validate the first screening performed by UNIFI, a refinement of the selection process was conducted through an online meeting attended by all research partners. During the meeting, each partner was assigned to a specific element of the matrix according to its expertise, in order to identify the five papers (or more, if appropriate) that best fit the purposes of SuperRED, based on the early selection made by UNIFI. ITD-CNR researchers were assigned

to methods and models for LD/SRL, but due to their wide expertise, they also supported TUDelft researchers in the papers' selection for the tools and technologies component, while UOC researchers focused on LE. Within the end of this phase, partners identified the papers to be included in the analysis, namely six papers for elements A1-A2 and B1-B2, and five papers for elementsA3-B3.

Phase 3 - Analysis of the papers: UNIFI red and analysed the selected papers on the basis of coding table, which included the following categories:

- General Information: Authors, Title, Year, Source Title, Abstract, Keywords.
- Aims and Methods: Aims of the study, Type of study design (if applicable), Sample (if applicable), Research questions or objectives.
- Results and Implications: Findings (particularly those useful for supporting LD and SRL), Challenges, and Barriers.

The coded information was then structured as a draft version of guidelines for supporting LD and SRL processes on the side of teachers and students. To finalize the framework, a questionnaire for teachers was developed to better align these early guidelines with teachers' needs and practices.

2.2.2 *Results of the literature review*

Prior to presenting the findings from the survey, an overview of the main results of the literature review is provided in the following paragraphs.

2.2.2.1 Learning Design Methods and Models

Six papers were analysed and the main themes regarding "LD and Methods and Models" emphasize the importance of clarifying the focus of the learning event and defining the design level. Attention should be paid to the context, considering the background, peculiarities of the actors involved, and the learning environment's affordances. Teaching strategies should align with learning objectives to enhance the learning experience's effectiveness. Relevant resources and tools should be integrated into a coherent time sequence. Learning interventions should include differentiated activities appropriate to students' abilities, with continuous monitoring and evaluation through both traditional and digital assessment. Finally, interventions should be adapted based on feedback and learning outcomes demonstrated in students' work.

2.2.2.2 Learning Design Tools and Technologies

Regarding "LD and Tools and Technologies", 6 papers were analysed. The main themes address the need for tools that support the LD phases (i.e., conceptualisation, Authoring, and Implementation) (see Chapter 1), while allowing for iterative transitions between these phases. These tools should accommodate diverse design needs, represent learning activity flows, and offer flexibility alongside structure. The design of collaborative learning activities should consider tasks, teams, time schedules, and technology, aligned with learning objectives and contextual constraints. Analytical frameworks highlight the importance of data analytics in enhancing LD, supporting reflective redesigns, and fostering community collaboration. Effective LD tools should be user-friendly, integrate with common web tools, and enable sharing and adaptation of pedagogical scenarios.

2.2.2.3 Learning Design and Learning Ecologies

Five papers were analysed in this element. The main themes regarding "LD and learning ecologies (LE)" focus on the integra-

tion of formal and informal learning strategies to support a continuum of learning contexts and practices. Effective LD should address pedagogical, technological, and contextual obstacles by providing flexible and differentiated designs, encouraging peer collaboration, and promoting digital learning strategies. Teachers should be trained to nurture these LE, incorporating ICT tools and self-directed learning methods. The study highlights the importance of comprehensive training, support from institutions, and the use of evaluative rubrics to enhance online courses and achieve stakeholder objectives, despite existing challenges in the educational landscape.

2.2.2.4 Self-Regulated Learning Methods and Models

Regarding "Methods and Models on SRL", 6 papers were analysed. The main emerging themes encompass understanding the cyclical phases of SRL, the importance of teacher training, and the integration of SRL practices across educational levels (see Chapter 1). Teachers need to be trained in SRL theories to effectively support students' learning processes. Additionally, creating learning environments that encourage self-regulation and employing feedback tools to enhance regulatory processes are critical. Studies also highlight the significance of motivation and emotional regulation, the use of technology in SRL, and the positive impact of perceived competence on students' ability to manage learning tasks.

2.2.2.5 Self-Regulated Learning Tools and Technologies

The main themes regarding tools, based on the 6 papers analysed for SRL in technology-enhanced learning environments, include investigating the characteristics of SRL research within higher education, focusing on specific areas of knowledge, and identifying preferred methodological approaches. The studies address the impact of emotions on cognitive and metacognitive processes, the role of learning dashboards in goal setting and

monitoring, and the methods used to measure and promote SRL in e-learning environments. Additionally, studies explore the effectiveness of various interventions and tools designed to support SRL strategies, considering their educational context, design characteristics, and the impact on learners' self-regulation activities.

2.2.2.6 Self-Regulated Learning and Learning Ecologies

The main themes for "SRL and LE" emerged from the 5 papers analysed, which emphasize the promotion of tools and attitudes that foster the development of Personal Learning Environments (PLEs) and guide students in creating Personal Development Plans (PDPs). They advocate linking formal and informal learning environments through Enterprise Social Network Systems (ESNs) and encouraging the use of web resources and technologies that support learner autonomy and self-direction.

2.2.4 The survey

To complement the literature review, a survey was designed to capture teachers' knowledge, experiences, and needs related to the implementation of LD and SRL in classrooms. This step was crucial for generating meaningful guidelines, that is a methodological guide which was not only theoretically sound but also practically applicable in real-world teaching and learning scenarios. The framework, indeed, was conceived as serving the purpose of providing guidance to the teachers during the subsequent phases of the SuperRED project, that is the co-design and implementation phases in the classrooms.

The survey was administered to teachers from the SuperRED school partners between June and July 2022. It was organized into three main areas, including general information, items on LD, and items on SRL. The questionnaire was implemented using Qualtrics and was administered in four different languages according to the countries involved in the project (English, Italian, Catalan, and Dutch).

The research partners were actively involved in building the questionnaire and supporting school partners during its completion. In total, 47 teachers from the three partner schools completed the survey. Their responses provided valuable insights into the practical challenges and needs faced by educators in implementing LD and SRL.

By integrating the literature review with the survey results, the SuperRED framework was refined to better meet the needs of teachers, ensuring its relevance and applicability in diverse educational contexts. This comprehensive approach allowed the framework to address both theoretical and practical dimensions of LD and SRL, making it a robust tool for enhancing digital education practices.

The LD section in the questionnaire moves from a definition of the LD construct, borrowed from the inspiring work of Conole (2013, p. 53):

> A methodology for enabling teachers/designers to make more informed decisions in how they go about designing learning activities and interventions, which is pedagogically informed and makes effective use of appropriate resources and technologies. This includes the design of resources and individual learning activities right up to curriculum-level design.

Teachers were asked whether they had some knowledge about LD as defined above. According to the data collected, 31 out of 47 teachers had some familiarity with it, recognizing several aspects related to their teaching/learning practices. Notably, 18 out of 47 teachers identified a moderate amount of aspects in the LD definition that they used in their practice, while 13 out of 47 teachers found many aspects already applied in their practice. This data indicates that a significant number of teachers were familiar with the LD approach and applied some of its principles in their daily practice.

More specifically, considering the different levels of LD intervention (macro and micro level), the majority of teachers engaged in macro-designing (high-level conceptualisation) and micro-designing (detailed planning) of learning activities, both in face-to-face and remote settings (more details on the theoretical aspects of LD levels are described in Chapter 1). For example, 13 out of 47 teachers engaged in macro-designing and 23 out of 47 in micro-designing. Additionally, 25 out of 47 teachers implemented learning activities, and 20 out of 47 orchestrated learning activities in both contexts. Reflective practices, such as collecting data for monitoring and evaluation, were performed by 14 out of 47 teachers in both contexts and 13 out of 47 only in face-to-face contexts. Re-designing activities for re-use or sharing purposes were also commonly reported (17 out of 47 teachers).

The use of LD tools among teachers revealed a heterogeneous situation. While some teachers regularly used LD tools (e.g., softwares or web apps that support the LD process, bringing together school context information - learning objective(s) - learning activities plan) , others did not feel confident enough in using them. The frequency of tool usage varied depending on the type of tool. For instance, macro-design tools (e.g., tools like 4Ts game, see Chapter 3) were rarely or sometimes used by 24 out of 47 teachers, while planning tools (e.g., tools like Pedagogical Planner, see Pozzi et al., 2020) were used by the majority (24 out of 47) either rarely or sometimes. Implementation tools were constantly used by 13 out of 47 teachers, whereas orchestration tools were rarely used, with 19 out of 47 teachers reporting they never used them. Evaluation tools saw constant use by 13 out of 47 teachers, and self-created tools for design were used regularly by 15 out of 47 teachers.

To understand the challenges faced by teachers in designing for learning, the survey included questions about the main difficulties encountered. The lack of time (reported by 30 out of 47

teachers) and the scarcity of resources (reported by 15 out of 47 teachers) were identified as the primary hurdles. Additional comments highlighted an absence of knowledge and training in LD (e.g., T31: "Poor knowledge"; T37: "Lack of training"). Consequently, teachers expressed a need for more support in LD, specifically requesting LD models (31 out of 47) and LD tools (27 out of 47) for guidance and assistance in designing learning activities. Moreover, 30 out of 47 teachers believed that LD is transversal to disciplines.

The survey also investigated changes in LD practices during the lockdown period. More than half of the teachers (24 out of 47) reported modifying aspects related to lesson delivery. Open-ended responses revealed that teachers reshaped their lecturing with the introduction of new technologies and teaching strategies, to deliver more interactive and engaging teaching. Examples included using different learning channels, graphic platforms, animated videos, and interactive tools such as presentations, Google Forms, interactive games, and flipped classrooms. Teachers also focused on controlling students' attention, improving digital competences, and enhancing independent work.

Similarly to the LD section, the survey explored teachers' familiarity with SRL based on the definition provided by Pintrich (2000, p. 453), that is: "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". While 13 out of 47 teachers had never heard of SRL, the majority (28 out of 47) were somewhat familiar with the concept. Specifically, 13 out of 47 had heard of SRL but had not tried to develop it in their students, 12 out of 47 sometimes tried to develop SRL skills, and 3 out of 47 consistently worked on developing these skills.

The results showed that 8 out of 47 teachers were not familiar with any aspects of SRL, while 36 out of 47 recognized some

aspects, and 3 teachers felt confident in their understanding, recognizing most or all aspects of the definition.

The questionnaire also explored teachers' perceptions of students' ability to self-regulate their learning. The majority, which means 25 out of 47 declared that the SRL abilities of their students were "poor" or "absent" while for 12 teachers out of 47 they were "acceptable", and for only 2 teachers they were "moderate". The mean percentage of students able to self-regulate their learning process was estimated at 32.69% by the respondents.

As far as the strategies and tools used to support SRL (e.g., digital tools that track the learning process for monitoring the achievement of objectives, the advancements in activities, the timing, etc.) are concerned, 8 out of 47 teachers did not provide any answers. Tools and strategies allowing students to make choices about how, when, and with whom they learn were used by 10 out of 47 teachers in both face-to-face and remote settings, although the overall usage was rare (13 out of 47). Meta-reflection strategies and tools were adopted by 17 out of 47 teachers, while programs or applications for tracking learning progress and setting goals were used sometimes by 12 out of 47 teachers, with 11 out of 47 not feeling familiar enough to use them. Learning strategies aimed at promoting motivation and overcoming difficulties were used by 26 out of 47 teachers, either in both settings or only in face-to-face situations, but even in this case the usage was generally rare.

By integrating the literature review with the survey results, the SuperRED framework was refined to better meet the needs of teachers, ensuring its relevance and applicability in diverse educational settings. This comprehensive approach made the framework relevant for addressing both theoretical and practical dimensions of LD and SRL, which was a priority of the SuperRED project.

A last question explored teachers' understanding of the influence of the discipline on the adoption of SRLstrategies/tools.

In this regard, 28 out of 47 teachers indicated that they can be applied to "all disciplines" while 7 out of 47 stated that they "don't know", only 3 teachers opted for "Mainly to Humanities" and 1 teacher for "Mainly to scientific disciplines".

The main difficulties declared by the teachers in using SRLstrategies/tools were the "Selection of suitable tools" (24 out of 47), the "Feedback management" (17 out of 47), the "Emotions' management" (10 out of 47) and the "Configuration of the tools" (9 out of 47). With regards to the strategies and tools used to support students' SRL practice in different contexts, "Self-evaluation tools" (29 out of 47), "Time planning tools" (13 out of 47), "Goal setting strategies" (12 out of 47) and "Motivational strategies" (11 out of 47) were the most selected options. Results about "peer feedback" indicate that it's encouraged "Constantly" by 7 teachers, "Sometimes" by 24 and "Rarely" or "Never" by 4 teachers. Finally, "Feedback" is provided "Monthly" and "Weekly" respectively by 23 and 13 teachers, only 4 selected the "Daily" option. Finally, the majority of teachers declared that constantly (13 out of 47) or sometimes (20 out of 47) they try to teach students to make aware choices concerning how to self-regulate their learning.

2.3 Framework validation

The SuperRED framework, developed through the integration of literature analysis and survey results, was also the object of a validation process involving an international panel of external experts (two teachers and two researchers) to ensure impartiality and breadth of perspective. The validation focused on three key aspects, i.e. *Clarity and Understandability*, referring to whether the guidelines were clear and easy to understand; *Consistency*, meaning whether the guidelines were logically consistent and aligned with the dimensions of methods and models, tools and

technologies, and LE; and *Significance*, relating to the relevance and importance of the guidelines in supporting effective LD and SRL.

From the results of the validation process, it emerges an overall agreement among the experts about the clarity and understandability of the LD guidelines, in all perspectives considered. Specifically, for the methods and models dimension, 2/4 experts agreed and 1/4 strongly agreed that the guidelines were clear; for the tools and technologies dimension, 4/4 experts agreed, and for the LE dimension, 3/4 experts agreed that the guidelines were understandable.

Regarding the criterion related to the consistency of the LD guidelines, a strong agreement among experts emerged on the different aspects. For the methods and models dimension, 2/4 experts strongly agreed and 1/4 agreed that the guidelines were consistent, for the tools and technologies dimension, 2/4 experts strongly agreed and 2/4 agreed about their consistency, and finally for the LE dimension, 2/4 experts strongly agreed and 1/4 agreed that the LD recommendations were coherent.

When evaluating the significance of the LD guidelines, the feedback was equally positive. For the methods and models dimension, 2/4 experts strongly agreed and 1/4 agreed that they were significant, for the tools and technologies dimension, 2/4 experts strongly agreed and 2/4 agreed about their meaningfulness, and for the LE dimension, 2/4 experts strongly agreed and 2/4 agreed that they were relevant.

The SRL guidelines received similar levels of positive feedback. For clarity and understandability, 1/4 expert strongly agreed and 3/4 experts agreed on the clarity of methods and models, for the tools and technologies dimension, 2/4 experts strongly agreed and 2/4 agreed, and for the LE dimension, 1/4 expert strongly agreed and 3/4 agreed about the clarity of the suggestions provided through the guidelines.

The significance of the SRL guidelines also showed high agree-

ment. For all the dimensions, 2/4 experts strongly agreed and 2/4 agreed on its significance.

In the open-ended questions, experts provided valuable feedback for further refinement of the framework. Key comments included suggestions for their improvement from a more practical perspective:

Expert 1: "*I think that the work is clear and gathers all the important theoretical elements to be taken into account for the learning design. However, I think it is developed from an academic point of view. To serve as a basis for working with teachers I would add practical examples where the theory expressed is put into play. Even images, graphs, diagrams, that help to better visualize what is intended to be said. This would prevent the proposal from being seen in an abstract way with difficulties to see how it works in reality.*"

Expert 2: "*SuperRED suggestions can be enriched with practical examples to be clearer and more understandable to a different audience (perhaps in bulleted list form?.*"

Based on this feedback, the team decided to enhance the practical aspects of the guidelines during the testing phase of the project to provide more comprehensive support to teachers.

2.4 The SuperRED Framework

As a result of the literature review, the teachers' survey and the feedback from experts, the SuperRED framework was delivered to serve as a vital resource for educators, offering a structured approach to enhancing digital readiness and promoting SRL. Through its comprehensive and practical guidelines, the framework supports the continuous improvement of teaching practices and the advancement of educational outcomes in a rapidly evolv-

ing digital landscape. In this paragraph, we provide a detailed description of the guidelines focusing on the themes and the perspectives together with a summary for an easier consultation.

2.4.1 *Guidelines for Learning Design*

2.4.1.1 Methods and model

The first guideline underlines that during the design of a learning event, it is essential to clarify its focus and define the design level, suggesting the need to determine whether teachers are working on a learning activity (micro level, a few hours of learning), a block level (meso level, usually a semester's work), or an entire course program (macro level). To visualize ideas and express the elements (and their relationships) of the design, teachers can choose a written description or use schemes, drawings, models, or symbolic representations, such as the main objective of the training, target audience, and learning activities (Goodyear & Dimitriadis, 2013; Conole, 2012).

The second guideline emphasizes paying attention to the context in which the intervention will take place, including the background and peculiarities of the actors involved, as well as the affordances of the learning environment. The learning environment itself influences learning, so what is available in the learning environment (face-to-face, remote, or blended learning) should never be left to chance. Spend time observing the class group and its individual members. Additionally, it is important to consider the nature of the relationship between learners and the teacher, what should be learned, and how it should be achieved (Goodyear & Dimitriadis, 2013; Conole, 2012).

The third guideline provides advice on defining teaching strategies in accordance with learning objectives to increase the effectiveness of the learning experience. Teachers should identify specific teaching strategies, such as flipped teaching, problem-

based learning, and collaborative learning, according to the learning objectives and the specific needs of the context. These strategies should be appropriately defined while considering the type of learning objective to be pursued (Pozzi, Manganello, & Persico, 2022; Bond, 2020; Pozzi, Ceregini & Persico, 2015).

The fourth guideline highlights the importance of integrating relevant resources and tools in a time sequence. Resources can be human, technological, or artifacts designed for learning, such as models, diagrams, or lesson plans. When choosing resources and tools the students' level of competence should be carefully considered. For instance technologies that students and parents are already familiar with, such as social media channels like WhatsApp, and different learning materials to increase accessibility, for example through written activity directions, tutorials, or concept maps (Mor, Craft & Maina, 2015; Conole, 2012; Bond, 2020).

According to the fifth guideline, running the learning intervention involves providing differentiated activities and ensuring that tasks are not assigned above or below students' abilities. Students often need to experience an appropriate combination of autonomy and just-in-time support, where a teacher or technology agent helps them balance autonomy with timely guidance. During the execution of the learning event, the teacher may allow students the freedom to choose digital and/or analog tools they want to work with, such as tablets or books, or instruct students on group work dynamics, for example, working in teams of four or choosing their own learning project (Goodyear & Dimitriadis, 2013; Conole, 2012; Bond, 2020).

The sixth guideline stresses the importance of monitoring and evaluating the effectiveness of the intervention by providing different forms of assessment, both traditional and digital. Consistency between objectives, learning approaches, and evaluation strategies, including formative and summative assessment, peer assessment, and self-assessment should be ensured as well as different actors, such as teachers, students, and peers should be con-

sidered, . for instance, providing recorded feedback on annotated tasks, using apps like Kahoot to provide quick snapshots of understanding, or utilizing Zoom meeting rooms for small group assessments (Conole, 2012; Bond, 2020).

Finally, the seventh guideline suggests adapting the intervention based on the feedback received. Learning outcomes, such as new knowledge, skills, and abilities, manifested in students' artifacts and daily work should be taken into account. The feedback may lead to a revision of the initial idea of the learning intervention, as design and redesign are intimately related (Bower & Vlachopoulos, 2018; Mor, Craft, & Maina, 2015; Goodyear & Dimitriadis, 2013; Conole, 2012).

2.4.1.2 Tools and technology

In the context of LD, the use of LD tools is highly recommended. The first guideline suggests using a LD tool both to reflect on teachers' way of thinking and behaving and to foster a different approach. Specifically, the use of a LD tool can promote a smoother and more organic design experience for novice teachers or for those who usually design in a rough fashion. Additionally, it can enhance creativity for teachers who tend to design in a regimented way (Pozzi et al., 2020).

The second guideline emphasizes the importance of sharing the design activity to sustain online collaboration and peer review. Sharing LD among teachers supports collaboration and peer review, thus building a pedagogical knowledge community. The online interaction among teachers leads to knowledge co-construction, improving their ability to reconsider their approaches to LD (Laurillard et al., 2018).

The third guideline encourages exploiting data to inform the LD process and community building, in accordance with GDPR regulations. The use of educational data for the LD process is strongly encouraged. Good practices for LD from a data-driven perspective include support at three levels: (i) evidence-based re-

flective redesign of learning activities using data from course enactment (learning analytics); (ii) scaffolding the design process through analyses of the pedagogical intentions reflected in the design (design analytics); and (iii) inspiration and awareness of colleagues' design activities (community analytics) (Hernández Leo et al., 2019; Kurvits, Laanpere, & Väljataga, 2015).

2.4.1.3 Learning ecologies

When considering the design of LE, the first guideline advises that it is crucial to take into account student agency, learner intentions, motivations, and past trajectories in developing learning strategies. From this perspective, a lifelong learning ecology supports the design of digital learning scenarios by intentionally connecting learning activities across a continuum of practices and contexts – formal, informal, and non-formal (Peters & Romero, 2019).

The second guideline highlights the importance of incorporating ICT resources both as elements and as training strategies to enhance teachers' LE, particularly in the context of continuing professional development. Referring to the lock-down period due to COVID-19, online resources have become key components of teachers' current LE. Thus, these resources should be integrated into the teachers' training systems and, more broadly, into their continuing professional development (González-Such et al., 2021).

The third guideline emphasizes addressing pedagogical, technological, and contextual areas during the LD process. These areas must be considered for reflection and appropriate decision-making to promote the optimal construction and development of LE. This careful consideration helps avoid faulty implementations that could lead to barriers or obstacles to proper learning ecology development (Santos-Caamaño, Vázquez-Cancelo & Rodríguez, 2021).

Learning Design
Methods/Model
1. Clarify the focus of your learning event and define the design level you are working on. 2. Pay attention to the context in which the intervention takes place: the background and peculiarities of the actors involved as well as the affordances of the learning environment. 3. Define the teaching strategies in accordance with the learning objectives in order to increase the effectiveness of the learning experience. 4. Highlight relevant resources and tools, and integrate them in a time sequence. 5. Run the learning intervention: provide differentiated activities and ensure that tasks are not assigned above or below students' abilities. 6. Monitor and evaluate the effectiveness of the intervention providing different forms of assessment, traditional and digital. 7. Adapt the intervention on the basis of the feedback received: take into account the learning outcomes (new knowledge, skills, abilities) manifested in students' artifacts and pupils' daily work.
Tools/Technologies
1. Use a LD tool both to reflect on teachers' way of thinking and behaving or to foster a different approach. 2. Share your design for sustaining the online collaboration and peer-review. 3. When possible, exploit the data for informing the LD process and community building, according to the GDPR.
Learning Ecologies
1. Take into account the student agency, learner intentions and motivations as well as past trajectories in developing learning strategies for the individual LE perspective. 2. Incorporate ICT resources both as elements and as training strategies to improve teachers LE in the perspective of continuing professional development. 3. Pedagogical, technological and contextual areas are the most important to be addressed during the LD.

Table 1: The SuperRED guidelines for Learning Design

2.4.2 *Guidelines for Self-Regulated Learning*

2.4.2.1 Methods and model

When it comes to SRL, it is important to engage learners by considering their purposes, intents, and goals. The first guideline highlights that regulation has different dimensions, involving mo-

tivational, emotional, behavioral, and cognitive aspects that influence one another. Capitalizing on the diversity of motivations, expectations, and prior knowledges and experiences inherent within all cohorts is of fundamental relevance (Zimmerman, 2002; Panadero, 2017; Hadwin, Jarvela, & Miller, 2016; Zimmerman, 2008; Pelikan et al., 2021). Moreover, since engagement is multidimensional (e.g., engagement with content, teachers, peers, or the community), all types of interaction should be considered when planning media use, including traditional media (printed, broadcast, or recorded) and newer teleconference media (Moore, 1989).

The second guideline advises enabling learners to link theory and practice by setting personal goals or personalizing the course's goals. Helping learners reflecting on the knowledge gained from the course and how it can be embedded into their practices before the course ends contributes to making them more engaged and motivated in the learning process (Zimmerman, 2002; Hadwin, Jarvela, & Miller, 2016; Zimmerman, 2008; Pelikan et al., 2021). Facilitating regulation also requires understanding the beliefs, self-perceptions, and mental models that shape and are shaped by observed actions and reactions over time and events (Zimmerman, 2002; Hadwin, Jarvela, & Miller, 2016; Zimmerman, 2008).

Since regulation involves a cyclical adaptation between three phases (forethought, performance, and self-reflection), the third guideline emphasizes regulation as a temporally unfolding process that emerges from and continues to shape future beliefs, knowledge, and experiences. Examining regulation requires collecting data over time and context. Support learners in continually monitoring their learning to determine its ultimate value beyond their immediate learning experience (Zimmerman, 2002; Panadero, 2017; Hadwin, Jarvela, & Miller, 2016; Zimmerman, 2008).

The fourth guideline suggests preparing learners to adaptively respond to new challenges, situations, or failures since regulation is socially situated, involving dynamic interplay between learners,

tasks, teachers, peers, parents, context, and cultures. Regulation emerges when learners engage with personally meaningful learning activities and situations infused with personal meaning, outcome utility, task value, and past experiences (Zimmerman, 2002; Hadwin, Jarvela, & Miller, 2016; Zimmerman, 2008; Pelikan et al., 2021). Regulation is strategically enacted when self, task, domain, or social conditions demand it (Zimmerman, 2002; Hadwin, Jarvela, & Miller, 2016; Zimmerman, 2008; Pelikan et al., 2021).

2.4.2.2 Tools and technologies

When choosing tools and technologies for SRL, it is important to select those that emphasize setting clear goals, self-assessment, and feedback. The first guideline suggests using tools that implement mechanisms allowing learners to set their learning goals, such as selecting skills to develop or defining activities to be completed by certain deadlines. These tools should provide feedback when learners complete evaluation activities suggested in the course, offering them information to assess their progress (Jivet et al., 2021; Pérez-Álvarez, Maldonado-Mahauad, & Pérez-Sanagustín, 2018; Broadbent, Panadero, & Fuller-Tyszkiewicz, 2020; Taub et al., 2021). Feedback is essential for regulation, therefore it is recommended the use of tools that offer textual feedback through motivational messages, presenting correct answers, time invested, or notifications (Jivet et al., 2021; Pérez-Álvarez, Maldonado-Mahauad, & Pérez-Sanagustín, 2018).

The second guideline emphasizes using tools that support visual mechanisms, interactivity, social comparison, and help-seeking. Tools that display learner progress or interaction with activities using graphs, tables, networks, calendars, or progress bar visualizations, such as conceptual maps to present learner-produced objectives, should be preferred (Taub et al., 2021; Araka et al., 2020; Broadbent, Panadero, & Fuller-Tyszkiewicz, 2020; Pérez-Álvarez, Maldonado-Mahauad, & Pérez-Sanagustín, 2018).

Help-seeking is generally supported by tools enabling shared spaces, forums, chats, or integrating social networks, wikis, or blogs. Organizational support is provided by tools allowing the use of notebooks or the generation of concept maps for content organization (Jivet et al., 2021; Pérez-Álvarez, Maldonado-Mahauad, & Pérez-Sanagustín, 2018). Tools that enable interactivity are also suggested since that allow students to interact with information and select activities to analyze, positively affecting learners' motivation. The social comparison component has a positive effect on time management and learners' commitment (Taub et al., 2021; Araka et al., 2020; Broadbent, Panadero, & Fuller-Tyszkiewicz, 2020; Pérez-Álvarez, Maldonado-Mahauad, & Pérez-Sanagustín, 2018).

The third guideline advises considering cognitive load when selecting suitable tools and applying strategies to balance it. In all phases of self-regulation, learners need to invest cognitive and metacognitive resources in addition to dealing with the learning task. The affordances of self-regulation thus amplify cognitive load, which is further increased by the tool's learning curve. Teachers should consider instructing and providing feedback to students about monitoring their learning curves (Taub et al., 2021; Broadbent, Panadero, & Fuller-Tyszkiewicz, 2020; Pérez-Álvarez, Maldonado-Mahauad, & Pérez-Sanagustín, 2018).

The fourth guideline suggests using tools that allow users to note their comments, recommendations, and inputs. These tools recommend learning objectives or activities, learning routes, strategies, or tips for SRL, using mechanisms for allowing data entry by the learner. Learners can define and plan their goals, record the time and reason for interruptions, mark the beginning and end of activities, and record the level of activity completion (Broadbent, Panadero, & Fuller-Tyszkiewicz, 2020; Pérez-Álvarez, Maldonado-Mahauad, & Pérez-Sanagustín, 2018).

The fifth guideline advises taking into consideration aspects such as usability and satisfaction, but also accessibility and its im-

pact on learners' self-regulation behaviour when choosing a tool. Teachers should focus on analysing behavioral patterns from learners' traces, regarding goal setting, goal fulfillment, the gap between established and achieved goals, and the percentage of goals achieved (Urbina, Villatoro, & Salinas, 2021; Pérez-Álvarez, Maldonado-Mahauad, & Pérez-Sanagustín, 2018).

2.4.2.3 Learning ecologies

To foster the development of a Personal Learning Environment (PLE), it is important to promote tools and attitudes that support this goal. The first guideline suggests creating a personal learning space with social media and apps such as blogs, wikis, Google Calendar, YouTube, and social bookmarking. These tools enable students to engage in self-regulation of learning processes, such as goal setting and planning. Additionally, promoting the use of social media for collaborative activities and aggregating information helps students reflect on their learning experiences. Collecting useful resources for learning, promoting social relations between students and teachers, and supporting students in their learning activities are crucial components (Dabbagh & Kitsantas, 2012).

The second guideline advises guiding students in constructing a Personal Development Planning (PDP). PDP practices encourage self-directed and SRL and embrace the idea of LE. Students are encouraged to follow activities such as thinking and planning, doing, recording, reflecting, evaluating, using the personal knowledge gained to change thinking (Jackson, 2015).

The third guideline highlights the importance of linking formal and informal learning environments with Enterprise Social Network Systems (ESNs). ESNs can create learning environments that support learning in informal contexts as well. An online learning community facilitated by an ESN can help ideas flourish across courses, which are typically isolated in a traditional learning system. ESNs allow students in a formal class to easily interact

with others who are not enrolled in the class but can contribute to their learning (Scott, Sorokti, & Merrell, 2016).

The fourth guideline encourages the use of web resources and technologies that support learners' autonomy and self-direction. There are various web-enabling services and technologies that permeate formal, non-formal, and informal learning, such as current awareness techniques (e.g., Flipboard, Evernote) and social networks and communities (e.g., Facebook, Twitter, Pinterest) (Maina & González, 2016).

Self-Regulated Learning
Methods/Model
1. Being regulation multifaceted involving motivational, emotional, behavioral, and cognition aspects, engage learners considering their purposes, intents, and goals. 2. Enable learners to link theory and practice by setting personal goals, or personalizing course's goals. 3. Since regulation involves cyclical adaptation between three phases (forethought, performance and self-reflection), emphasize regulation as a temporally unfolding process emerging from, and continuing to shape, future beliefs, knowledge, and experiences. 4. Prepare your learner to adaptively respond to new challenges, situations or failure since regulation is socially situated involving dynamic interplay between learners, tasks, teachers, peers, parents, context, and cultures.
Tools/Technologies
1. Choose a tool that gives importance to clearly setting the goals, to self-assessment and feedback. 2. Use tools supporting visual mechanisms, interactivity, social comparison and help seeking. 3. When selecting the suitable tool, consider the cognitive load and apply strategies to balance it. 4. Use tools that allow users to note their comments, recommendations and inputs. 5. When choosing a tool, take into consideration not only aspects such as usability and satisfaction, but also accessibility and its impact on learners' self-regulation behaviour.

Learning Ecologies
1. Promote those tools and attitudes that lead to the development of a Personal Learning Environment (PLE). 2. Guide your students in the construction of a Personal Development Planning (PDP). 3. Make a link between formal and informal learning environments with Enterprise Social Network Systems (ESNs). 4. Encourage the use of web resources and technologies that support learners' autonomy and self-direction.

Table 2: The SuperRED guidelines for Self-Regulated Learning

2.5 Concluding remarks

The SuperRED framework represents a significant advancement in the field of educational design, particularly in the context of digital and remote education. It addresses critical gaps identified during the COVID-19 pandemic, highlighting the necessity for robust LD and SRL frameworks to support both teachers and students in diverse educational settings. The development of the SuperRED framework was a meticulous process, combining extensive literature reviews with comprehensive surveys to ensure both theoretical soundness and practical applicability.

Key to the framework's development was the recognition of the complex nature of learning environments and the importance of tailoring educational strategies to different educational settings (remote, blended, and face-to-face). This adaptability is crucial for fostering an inclusive and resilient educational system capable of responding to various challenges and needs. By integrating insights from teachers and leveraging a collaborative approach involving universities, research institutes, and schools, the SuperRED framework ensures relevance and utility in real-world educational practices.

The SuperRED framework offers practical tools and methodologies to enhance teaching and learning experiences. They em-

phasize the importance of clear goal setting, reflective practices, and continuous feedback, all essential components for effective LD and self-regulation. Moreover, the framework envisages the critical use of innovative tools and technologies, encouraging educators to integrate digital resources that support interactive and collaborative learning.

The validation process that involved international experts further points out the robustness of the framework. Feedback highlighted the need for practical examples and clearer visual aids, which will be incorporated in future iterations to enhance usability and clarity for teachers. This iterative approach to framework development ensures that it remains a living document, continually refined based on feedback and evolving educational needs.

References

Araka, E., Maina, E., Gitonga, R., & Oboko, R. (2020). Research trends in measurement and intervention tools for self-regulated learning for e-learning environments – systematic review (2008-2018). *Research and Practice in Technology Enhanced Learning*, 15(1), 1-21.

Barry, J. Zimmerman (2002). Becoming a Self-Regulated Learner: An Overview. Theory Into Practice, 41(2), 64-70. DOI: 10.1207/s15430421tip4102_2.

Bond, M. (2020). Schools and emergency remote education during the COVID-19 pandemic: A living rapid systematic review. *Asian Journal of Distance Education*, 15(2), 191-247.

Bower, M., & Vlachopoulos, P. (2018). A critical analysis of technology enhanced learning design frameworks. *British Journal of Educational Technology*, 49(6), 981-997.

Broadbent, J., Panadero, E., & Fuller-Tyszkiewicz, M. (2020). Effects of mobile-app learning diaries vs online training on specific self-regulated learning components. *Educational Technology Research and Development*, 68(5), 2351-2372.

Conole, G. (2012). *Design Languages and Learning Design. In Designing for Learning in an Open World*. London & New York: Springer.

Dabbagh, N., & Kitsantas, A. (2012). Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. *The Internet and Higher Education*, 15(1), 3-8.

Edisherashvili, N., Saks, K., Pedaste, M., & Leijen, Ä. (2022). Supporting Self-Regulated Learning in Distance Learning Contexts at Higher Education Level: Systematic Literature Review. *Frontiers in Psychology*, 12, 792422. doi: 10.3389/fpsyg.2021.792422. PMID: 35115989; PMCID: PMC8805682.

Giovannella, C., Passarelli, M., & Persico, D. (2020). Measuring the effect of the Covid-19 pandemic on the Italian Learning Ecosystems at the steady state: a school teachers' perspective. *Interaction Design and Architecture (s) Journal (IxD&A)*, (45).

González-Such, J., Perales, M. J., Ortega-Gaite, S., & Sánchez-Delgado, P. (2021). Teachers' Digital Learning Ecologies: School at Home During COVID-19 in the Valencian Region. *Publicaciones*, 51(3), 191-214.

Goodyear, P., & Dimitriadis, Y. (2013). In medias res: reframing design for learning. *Research in Learning Technology*, 21.

Hadwin, A., Jarvela, S., & Miller, K. (2016). Self-regulation, co-regulation and shared regulation in collaborative learning environments. In B. Zimmerman, & D. Schunk (Eds.), *Handbook of Self-Regulation of Learning and Performance* (2nd ed., pp. 83-106). Routledge.

Hernández Leo, D., Martinez Maldonado, R., Pardo, A., Muñoz Cristóbal, J. A., & Rodríguez Triana, M. J. (2019). Analytics for learning design: A layered framework and tools. *British Journal of Educational Technology*, 50(1), 139-152.

Jackson, N. (2015). Exploring Learning Ecologies: Habitats for Self-Directed, Self-Regulated, Learning, Development & Achievement.

Jivet, I., Wong, J., Scheffel, M., Valle Torre, M., Specht, M., & Drachsler, H. (2021, April). *Quantum of Choice: How learners' feedback monitoring decisions, goals and self-regulated learning skills are related. In LAK21: 11th international learning analytics and knowledge conference* (pp. 416-427).

Kurvits, M., Laanpere, M., & Väljataga, T. (2015, November). Analysis of tools and methods for describing and sharing reusable pedagogical

scenarios. In *International Conference on Web-Based Learning* (pp. 251-257). Springer, Cham.

Laurillard, D., Kennedy, E., Charlton, P., Wild, J., & Dimakopoulos, D. (2018). Using technology to develop teachers as designers of TEL: Evaluating the learning designer. *British Journal of Educational Technology*, 49(6), 1044-1058.

Maina, M. F., & González, I. G. (2016). Articulating Personal Pedagogies Through Learning Ecologies. *Lecture Notes in Educational Technology*, 9783662477236, 73-94. https://doi.org/10.1007/978-3-662-47724-3_5.

Moore, M. G. (1989). Editorial: Three types of interaction. *American Journal of Distance Education*, 3(2), 1-7. http://aris.teluq.uquebec.ca/portals/598/t3_moore1989.pdf.

Mor, Y., Craft, B., & Maina, M. (2015). Introduction. In Maina, Mor & Craft (Eds.), *The Art & Science of Learning Design*. Sense Publisher.

Panadero, E. (2017). A Review of Self-regulated Learning: Six Models and Four Directions for Research. *Frontiers in Psychology*, 8, 422.

Pelikan, E. R., Lüftenegger, M., Holzer, J., Korlat, S., Spiel, C., & Schober, B. (2021). Learning during COVID-19: the role of self-regulated learning, motivation, and procrastination for perceived competence. *Zeitschrift für Erziehungswissenschaft*, 24, 393-418. https://doi.org/10.1007/s11618-021-01002-x.

Pérez-Álvarez, R., Maldonado-Mahauad, J., & Pérez-Sanagustín, M. (2018, September). Tools to support self-regulated learning in online environments: Literature review. In *European Conference on Technology Enhanced Learning* (pp. 16-30). Springer, Cham.

Peters, M., & Romero, M. (2019). Lifelong learning ecologies in online higher education: Students' engagement in the continuum between formal and informal learning. *British Journal of Educational Technology*, 50(4), 1729-1743.

Pozzi, F., Asensio-Perez, J. I., Ceregini, A., Dagnino, F. M., Dimitriadis, Y., & Earp, J. (2020). Supporting and representing learning design with digital tools: in between guidance and flexibility. *Technology, Pedagogy and Education*, 29(1), 109-128.

Pozzi, F., Ceregini, A., & Persico, D. (2015). "ProgeTTTTare" l'apprendimento collaborativo con 4T. *TD Tecnologie Didattiche*, 23(3), 132-138.

Pozzi, F., Manganello, F., & Persico, D. (2022). A study on teachers' design choices regarding online collaborative learning. In *CSEDU*, 2, 599-605.

Queiruga Dios, M. Á., Dorrío, J. B. V., Sáiz-Manzanares, M. C., López-Iñesta, E., & Ojeda, M. D. (2021). Assessment of the virtualized self-regulated learning ecology for the Didactics of Natural Sciences during the COVID-19 crisis. *Publicaciones de La Facultad de Educacion y Humanidades Del Campus de Melilla*, 51(3), 375-397. https://doi.org/10.30827/publicaciones.v51i3.18046.

Ranieri M., Gaggioli C., & Borges M.K. (2020) *La didattica alla prova del Covid-19 In Italia. Uno studio sulla scuola primaria*. https://doi.org/10.5212/PraxEduc.v.15.16307.079

Santos-Caamaño, F., Vázquez-Cancelo, M. J., & Rodríguez, E. R. (2021). Obstacles in the development of learning ecologies: a challenge for expanded learning in pandemic scenarios. *Publicaciones*, 51(3), 515-531.

Scott, K. S., Sorokti, K. H., & Merrell, J. D. (2016). Learning "beyond the classroom" within an enterprise social network system. *The Internet and Higher Education*, 29, 75-90.

Taub, M., Azevedo, R., Rajendran, R., Cloude, E. B., Biswas, G., & Price, M. J. (2021). How are students' emotions related to the accuracy of cognitive and metacognitive processes during learning with an intelligent tutoring system? *Learning and Instruction*, 72, 101200.

Urbina, S., Villatoro, S., & Salinas, J. (2021). Self-Regulated Learning and Technology-Enhanced Learning Environments in Higher Education: A Scoping Review. *Sustainability*, 13(13), 7281. https://doi.org/10.3390/su13137281.

Zimmerman, B. J. (2002). Becoming a Self-Regulated Learner: An Overview. *Theory Into Practice*, 41(2), 64-70. DOI: 10.1207/s1-5430421tip4102_2.

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal*, 45(1), 166-183.

Chapter 3.
The SRL-4Ts game: a tool to foster the design of collaborative learning activities oriented to self-regulated learning

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3.1 Introduction

As already mentioned in Chapter 1, promoting Self-Regulated Learning (SRL) among students is a complex process that extends beyond direct interventions. For SRL to be effectively and sustainably promoted, it is essential that teachers are involved, trained, and fully supported. This enables them to plan educational interventions that target their students' SRL skills.

To this end, the Institute for Educational Technology of the National Research Council of Italy (CNR-ITD) has developed a tool for teachers called the "SRL-4Ts game" (Pozzi, Ceregini, Manganello, Passarelli, & Persico, 2022). This tool aims to assist teachers in designing learning activities that foster SRL. The SRL-4Ts game has the dual objective of enhancing teachers' general competence in Learning Design (LD) – i.e., their ability to systematically plan educational interventions – and facilitating, specifically, reflection on SRL processes and their promotion.

The tool is structured as a modular game, consisting of a "4Ts core module" (4Ts game®), which supports the design of col-

laborative learning activities, and the "SRL module", which incorporates a reflective component to enhance existing designs by increasing their capacity to promote SRL. Together, these components help teachers collaboratively design and refine learning activities in an engaging and playful manner.

3.2 The 4Ts Core Module

The 4Ts Core Module is designed as a collaborative game that conceptualises LD as co-designed, shared, and reusable entities, in alignment with the LD literature. When using this module, teachers engage in an iterative, social process involving: (a) decision-making based on the variables at play when designing a learning activity and the relationships among them; and (b) reflection on the LD principles that underpin collaborative learning and SRL development.

> The Core Module of the game has evolved over the years, beginning with a tangible board game version, developed back in 2015.

In this version, groups of teachers discuss and interact face-to-face to design a collaborative learning activity for their students. The process starts with identifying the goals, context, and learning content of the activity. During the game session, teachers use four decks of cards representing the Tasks assigned to students (red deck, 40 cards / 10 unique cards), the composition of the Teams (yellow deck, 24 cards / 6 unique cards), and the Technologies used (green deck, 32 cards / 8 unique cards). Additionally, content-independent Techniques or 'patterns' (e.g., the 'Jigsaw') can scaffold the design process, suggesting specific combinations of Task, Team, and Technology (blue deck, 15 cards, all unique). These Techniques effectively guide teachers in implementing

complex, well-tested patterns for collaborative learning. Specifically, the Module currently includes the following Techniques: Jigsaw, Peer Review, Case Study, Pyramid, Discussion, and Role Play. Throughout the game session, teachers read the prompts contained on the cards suggesting possible associations with other cards to create a meaningful design and discuss which Tasks, Teams, Technologies, and Techniques to use and arrange the cards on the board, which represents the Time dimension. The game features no turn-taking; discussion between teachers is open, and all cards are available at all times; players must simply read the prompts and agree on which cards they want to place on the board.

This collaborative approach allows teachers to design an activity following the 4Ts model presented in Chapter 1. By the end of the game session, teachers will have outlined the macro-design of a learning activity, represented by the specific selection and arrangement of cards on their board.

An example of the board state during a game session is shown in Fig. 1. The board is divided into four weeks. The positioning of the cards sets the timing of each Task. In the example shown in Fig. 1, participants are designing an activity using the 'Jigsaw' Technique (blue cards). They chose to insert two Tasks (red cards) in the first phase and one in the second phase, with the corresponding Teams (yellow cards) and Technologies (green cards).

In this scenario, the first Task students will undertake is reading and studying some materials individually using the web; the second Task is preparing a presentation in small groups (Expert Groups of the Jigsaw) using a presentation software. During the second phase of the Jigsaw (third week), Teams will be reformed in Jigsaw Groups (small groups) with the Task of writing a report using a writing software. Each Task will take one week.

Fig. 1. 4Ts Core module - The board of the tangible version

As already mentioned, cards not only indicate a Task/Team/Technology but also include a brief description and prompts or suggestions on how that card could be combined with others. For example, the "Commenting on someone else's work" Task card includes the following description:

> "Providing feedback about the work of others, with suggestions on how that work might be improved. It often follows and precedes a production task, e.g., 'Writing a text', 'Producing an artefact', 'Preparing a Presentation', because it aims to improve the product. It can be carried out individually (one-to-one feedback), in pairs, or in small groups (group-to-group feedback) and can be reciprocal or cyclic. The feedback may be produced using a text editor or wiki software and provided asynchronously in a forum or synchronously in face-to-face settings (no technology). This task requires a minimum of one week".

This description suggests combining this card with other specific Task cards (writing a text, producing an artefact, preparing a presentation), Team cards (pairs or small groups), and Technology cards (writing software, wiki software, forum, or no technology), in addition to providing a suggestion regarding the timing of the activity. The tangible version of the game was prototyped and tested with teachers (see Fig. 2), who appreciated its collaborative aspects and praised how it facilitated the LD process while still encouraging face-to-face interaction around a table. However, teachers also expressed the desire for a digital version of the game to facilitate the micro-planning of learning activities (Pozzi, Ceregini, & Persico, 2015, 2016). Additionally, this tangible version required the presence of a tutor to monitor the process and ensure that the combinations of Task, Team, Technology, and Technique cards – and their arrangement on the Time board – were consistent and logical. A digital version would allow for automated guidance and feedback, allowing the 4Ts core module to be used not only in highly scaffolded training settings, but also as a tool for teaching practice and a way to sketch out designs of learning activities and even share them with colleagues.

Fig. 2. 4Ts Core module - Teachers playing with the tangible version

To tap this potential, we developed a digital version of the 4Ts core module, focusing on replicating the tangible experience as closely as possible while including a system that would play – at least partially – the role of a tutor, informing teachers on the internal coherence of their design choices and helping them internalise the structure of the collaborative learning Techniques included in the game.

This digital version, created using Unity-based software, can be played collectively by teachers around an Interactive Whiteboard (IWB), though it can also be run on a computer or laptop (Fig. 3).

Fig. 3. 4Ts Core module – Teachers playing with the digital version

Importantly, the digital game features a knowledge base that understands all possible relationships among cards and can alert teachers if they choose an incompatible combination. Each time a card is added on the board, the system checks the board to verify its state. If an error is detected, the user must correct the card before continuing. A straightforward example of an incorrect combination would be pairing an Individual Study Task card with a Small Groups Team card. Less evident errors that the game can detect include errors in implementing a Technique (e.g., the Jigsaw technique has specific, codified phases) or omitting required steps in a LD (e.g., planning a presentation without including the Task Preparing a Presentation beforehand). Players can also benefit from automated feedback by requesting suggestions from the system, which is especially useful when implementing a specific Technique or by being alerted when a design is not complete (i.e. cards are missing).

Lastly, the digital version of the game allows for the saving and sharing of completed designs. In contrast, with the tangible ver-

sion, designs are impermanent, unless a picture of the complete board is taken.

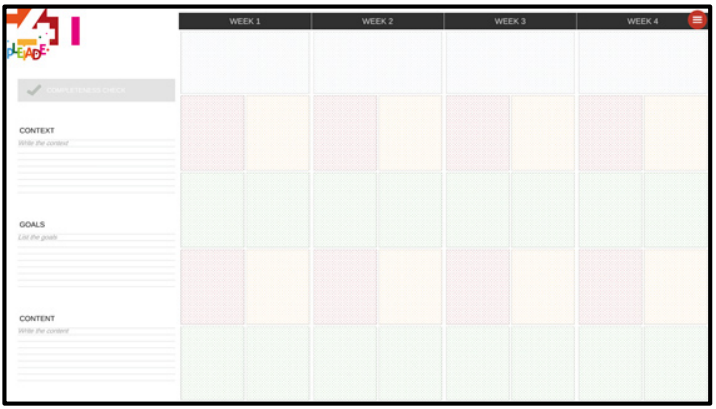

Fig. 4. 4Ts Core module - The board in the digital game

An example of a board state for the digital version of the module is shown in Fig. 4. In Fig. 5 you can see a different implementation of the Jigsaw Technique shown in Fig. 1.

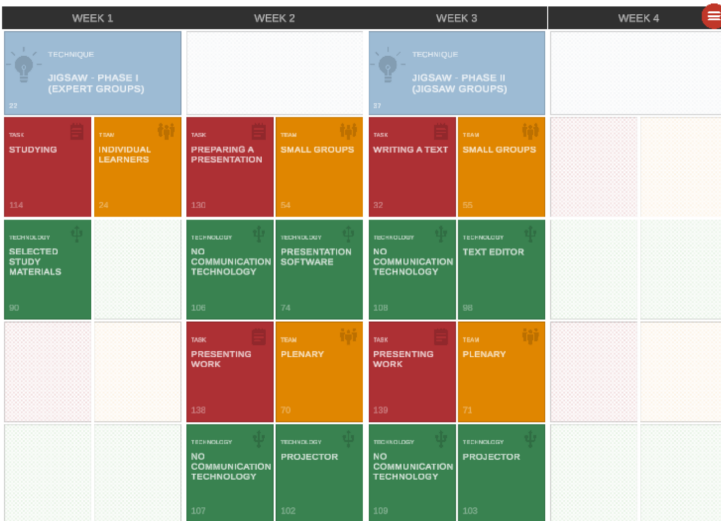

Fig. 5. 4Ts Core module - Example of the end result of a game session with the digital version.

In this case, teachers opted to use a specific Technique (blue cards) that led to choosing certain combinations of Task, Team, and Technology (red, yellow, and green cards, respectively). The Time is defined by the spatial position of the cards (see top header).

Since teachers specifically enjoyed the face-to-face interaction and the manipulation of physical components of the tangible version of the module, we recognised that the digital version, while offering a saving feature and automated feedback, was a trade-off in terms of teacher satisfaction.

To address this, we developed a hybrid digital/tangible version of the module. In this version, participants use physical decks and place the cards on a tangible board representing Time, exactly as they would in the tangible version of the game. However, a webcam mounted on a stick is used to capture and replicate the state

of the board on a digital implementation using a nearby laptop or interactive whiteboard. This is achieved via ArUco markers printed on the cards, which help the system identify each card univocally. These are markers composed of a wide black border and an inner binary matrix that acts as identifier; they basically work like QR codes, but they are smaller and openly available. Four additional ArUco markers are printed on the four corners of the board to help the system calibrate and recognise the position of each card on the board.

This way, teachers can interact with each other using the tangible components without the mediation of technology. At the same time, the digital implementation running on the laptop or interactive whiteboard will reproduce the state of the board and provide teachers real-time feedback on their design choices, as well as the ability to easily save the completed design at the end of the playing session.

In the following picture (Fig. 6) you can see a group of teachers while interacting with the hybrid version of the game.

Fig. 6. 4Ts Core module - Teachers playing with the hybrid version

The digital and hybrid versions of the game feature three "difficulty levels," offering different experiences in terms of scaffolding and freedom to design:

- **Level 1 (entry level):** Designed for teachers unfamiliar with the 4Ts model and its Techniques (Jigsaw, Pyramid, Peer Review, Discussion, Case Study, Role-play). In this highly scaffolded version, the session starts with teachers choosing a specific Technique to implement in their design. All their choices regarding Task, Team, Technology, and Time are checked for adherence to this Technique, with the system providing feedback if participants deviate significantly from the standard implementation. Additionally, teachers can ask the system to check for completeness, and it provides feedback about missing cards needed to complete the selected Technique. This level helps teachers learn Techniques in their standard forms, while internalising the 4Ts model's structure of learning activities as a succession of Tasks carried out in Teams, with or without the use of Technologies and organized in phases within a given Time frame;
- **Level 2 (advanced level):** Intended for actual collaborative learning activity design. Here, Technique cards are skipped and teachers only use Tasks, Teams and Technologies cards, that can be aggregated with more degrees of freedom. The feedback provided by the system focuses on the internal coherence and logical validity of the chosen Tasks, Teams, and Technologies. This level offers medium scaffolding, allowing freedom to personalise a learning activity design and adapt a Technique to a specific context, or even design an activity that does not necessarily follow any codified Technique;
- **Level 3 (expert level):** Maximises teachers' freedom, without any scaffolding. This level is for teachers already very familiar with LD and the 4Ts model, as the system provides no feedback or scaffolding. An addition specific to this level are wild

cards, which are blank cards that can represent Tasks, Teams, or Technologies that teachers come up with and that are not otherwise represented in the game.

The digital and hybrid versions of the 4Ts Core module are also featured with a "narrator", in the form of a Master Teacher who introduces the game to players when the game runs for the first time and provides the feedback of the system (see Fig. 7).

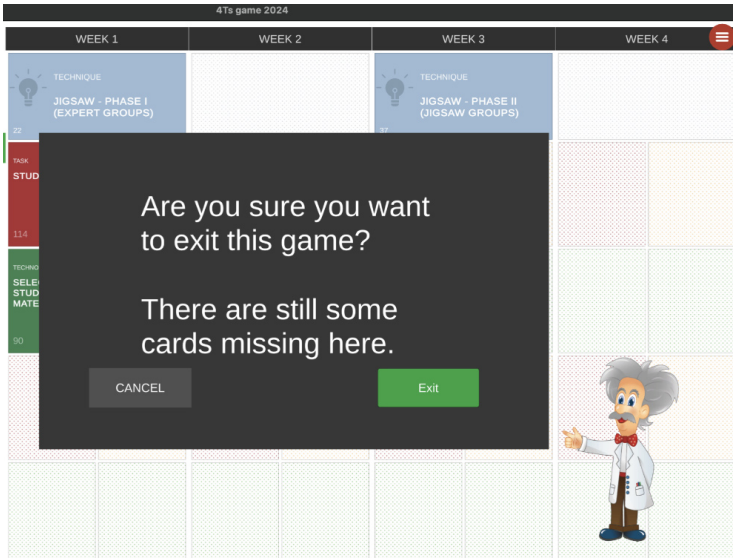

Fig. 7. 4Ts Core module - The Master Teacher provides feedback in the digital and hybrid versions

Lastly, the module is featured with a scoring system, which assigns positive points to correct cards placed on the board and negative points to cards wrongly associated or placed on the board. This provides an additional gamification mechanic thus limiting the risk that teachers randomly put cards on the board and pos-

sibly increasing the level of players' engagement and fun during the game session.

3.3 The SRL Module

One of the interesting features of the 4Ts Core Module is its potential to be expanded upon, focusing on specific aspects of teaching as needed. For the SuperRED project, which focused on promoting SRL, this took the form of an additional module (game) that would synergise with use of the Core Module, but that could also be used stand-alone.

The SRL module is a competitive game for 2-6 players that encourages teachers to reflect on the features of a design that promote students' SRL. This module is used to examine an already conceptualised design, making it suitable for use on the result of a game session with the 4Ts core module or on a LD created in any other format. Although the 4Ts Core Module and the SRL module are designed to be used sequentially, they can also be employed independently, depending on the needs and constraints of a teacher training event. Additionally, the design used as a starting point for the SRL Module game session does not need to be described using the 4Ts framework, as long as the structure of the activity (macro-design level) is clear. This flexibility allows the SRL Module to be easily integrated with different LD approaches.

Similar to the 4Ts Core module, the SRL Module can be played in a fully tangible version, a digital implementation, or a hybrid format, combining digital and tangible components (e.g., using a digital board with physical dice and cards, or digital cards with a tangible board and tokens; see Fig. 8).

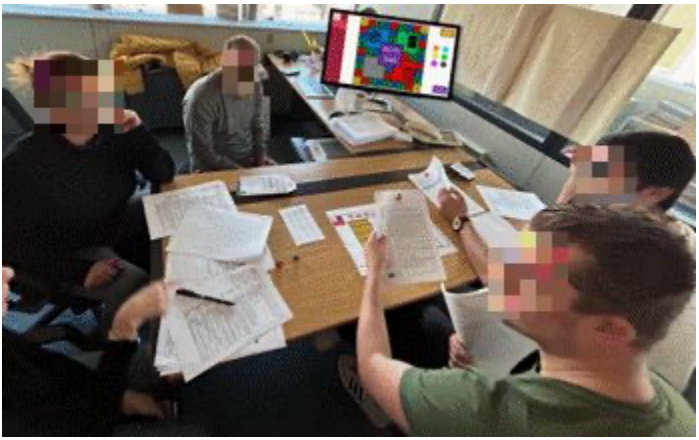

Fig. 8. SRL module – Teachers playing with the hybrid version

During a competitive game session using the SRL Module, teachers study the macro design of a learning activity with the aim of identifying and/or adding features that promote SRL within the learning activity design. This reflection process is supported by prompts based on Zimmerman's model of SRL and related literature (see Chapter 1 of this book), and more specifically on the rubric illustrated in Chapter 1. These prompts take the form of short design principles that are content-independent and relevant for any kind of activity, and they include examples to help teachers understand their practical application. For example, a prompt for Zimmerman's forethought phase is the principle: "Students' self-efficacy beliefs, i.e. students' beliefs in their own capacity to achieve the learning goals, are leveraged by the design," accompanied by the example "e.g., the design includes assessing and discussing students' self-efficacy beliefs, or puts all students in a self-assuring position." Another prompt for Zimmerman's self-reflection phase is "Students are involved in self-reflection activities on their own emotional reactions to success

or failure," with the example "e.g., seizing the opportunity of a student overreacting after a bad mark, the teacher invites all students to reflect on their emotional reactions." Overall, the prompts clarify that the examples are there to ease interpretation of the principle, but they represent only one possible way of implementing that principle in practice.

The game session with the SRL module is divided into a preparation phase and a playing phase. In the preparation phase, all teachers are provided (or choose) a design that represents the starting point of their playing session. This could be a design they created together using the 4Ts Core module, a design they created in any other way, or even a design provided by a teacher trainer. The design may be the same for all teachers, or each teacher may have a different design, depending on the specific goals and organisation of the playing/training session. All teachers are also provided with cards that represent the Zimmerman-inspired design principles that promote SRL (see Fig. 9 for a card example).

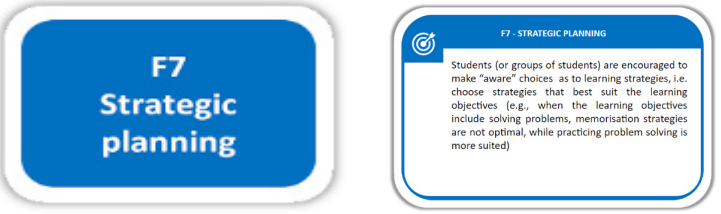

Fig. 9. SRL module - Front and back of an example of cards

All cards are double-sided: the front contains the card unique code ("F7" in the Figure, which stands for "Forethought prompt number 7") and the card title ("Strategic planning" in Fig. 9); the back contains the related SRL prompt (depending on the card colour, the prompts will focus on a specific phase of Zimmerman's

model of SRL: Forethought in blue, Performance in green, or Self-Reflection in red).

Teachers individually examine the design using these principles as a lens, trying to identify which principles are already implemented in the activity and which, in their view, *could* be implemented by changing some aspect of the activity. When they find a section of the design that implements a principle, or where a principle could be implemented, they track it by writing down in place the code that identifies a principle or by applying a sticker with the principle code on that part of the design. At the end of this phase, each player should have a fine-grained design and a number of SRL principles implemented (or added) in that design. This reflection phase is typically carried out in silence and could take from 15 to 45 minutes, according to participants' familiarity with the LD (e.g., if the design is the result of a 4Ts Core Module session, familiarity will already be high), and with the design principles included in the module.

Subsequently, in the playing phase, players take turns navigating a *Trivial Pursuit*-inspired board (see Fig. 10).

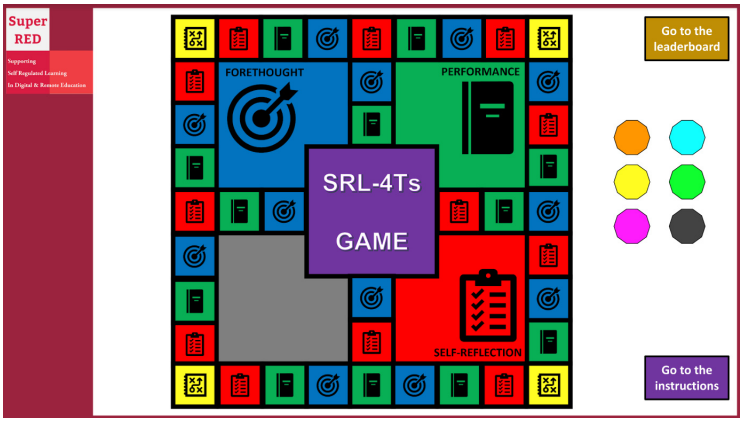

Fig. 10. SRL module – The board of the digital version

The main board contains 40 spaces: 12 for "Forethought" (blue), 12 for "Performance" (green), 12 for "Self-Reflection" (red) and 4 yellow for "Choice". The central, purple space is where all player's tokens will start. The coloured tokens on the right side of the screen, each representing a player, will be placed there before starting the game. The leaderboard (in a tangible or digital version) will also be placed beside the board (see Fig. 11).

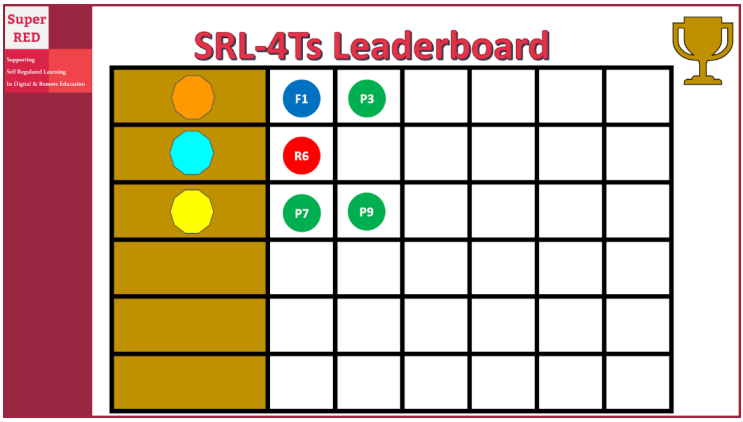

Fig. 11. SRL module - The Leader board

The starting player is chosen by rolling a die. On their turn, a player rolls a die (either a real one or a digitally-simulated one) and moves as many spaces as the die result. Players can choose the direction in which to move their token, and multiple tokens can occupy the same board space. Depending on the colour of the space where they end their movement, they will be presented with one of the prompts from the preparation phase:

- **Blue spaces:** Prompt regarding Forethought
- **Green spaces:** Prompt regarding Performance
- **Red spaces:** Prompt regarding Self-reflection
- **Yellow spaces:** Prompt for a phase of their choice

Within each category, the prompt is selected randomly by rolling a die (note that using real dice requires at least one 12-sided die). When presented with a prompt, the player must indicate if the principle described was present in their design and/or if they added a suggestion for its implementation. Other players act as judges to decide whether the principle was correctly identified or implemented. If it was, the acting player earns one point towards victory, represented by a sticker on the leaderboard (or an image overlay, if using the digital leaderboard). The sticker includes the code of the identified principle, so the leaderboard serves as a record of the principles examined during the game.

The game session lasts about an hour and ends by declaring winners in four different categories:

– **Main winner:** The player with the highest number of points.
– **Honourable mentions:** The players with the most points in the three different categories (Forethought, Performance, and Self-reflection).

3.4 Reception and future developments

Both modules of the game were used in different training activities conducted with in-service teachers of primary and lower secondary school.

Overall, teachers exhibited a positive reception towards both game modules and their underlying theoretical models.

Specifically, they found the 4Ts model easy to comprehend and useful for designing effective, systematic, and sharable collaborative activities (Pozzi, Ceregini, & Persico, 2016), and they appreciated the integration of Zimmerman's model in the SRL Module for reflecting on SRL-related aspects. This positive reception was consistent across both tangible and digital versions,

indicating that the core educational concepts were effectively conveyed regardless of the format.

In particular, regarding the 4Ts Core module we detected differences in preferences between the tangible and digital versions.

Teachers generally favoured the tangible version, particularly appreciating its usefulness in designing effective collaborative activities and producing coherent designs. The tactile nature of the tangible version seemed to facilitate a better understanding of the game elements and their interconnections. For instance, teachers reported that it was easier to understand and use the indications on the cards regarding possible links with other cards in the tangible game (Pozzi et al., 2022). Considering that the text written on the cards of the two versions of the game was the same and that reading it is essential to understand the rules of the game, teachers likely read the tangible cards more carefully, while they skimmed – or read less carefully – card text when presented on screen. Preference for the tangible version was also significant in several other areas, such as understanding the board layout and the utility of inclusion-related tips in triggering reflections on inclusion features in collaborative designs. These results align with studies that noted that teachers tend to dislike the use of technology (Pernin et al., 2011; Pozzi et al., 2017, 2022), which was one of the considerations that led to the development of the hybrid version of the game, allowing teachers to get feedback from the system while leveraging the advantages of the tangible version.

Conversely, while the digital version provided valuable automatic feedback that improved the overall quality of the collaborative designs, some teachers found the feedback and interface of the digital game less intuitive. Although the automated feedback enhanced the consistency and completeness of the designs, there was room for improvement in making the feedback more accessible and understandable. The digital format's automated checks and suggestions were beneficial, but teachers found the tangible

interaction with physical cards more engaging and easier to navigate. Additionally, observations of teachers' interactions with the digital game revealed that they sometimes adopted a trial-and-error strategy, trying multiple cards in a specific spot and over-relying on the automated feedback to determine whether the cards were suitable. This was what suggested the implementation of the scoring mechanism, i.e. to limit the risk teachers adopt such a trial-and-error strategy.

Regarding the hybrid version, specifically developed to leverage the best aspects of the tangible and digital versions, preliminary analysis of data revealed that teachers found the hybrid version more useful but less easy to use (Pozzi et al. 2024). This difficulty likely stemmed from the physical setup of the hybrid game, which involved a webcam mounted on a pole and a physical board prone to misalignment (see next section). Consequently, hybrid game sessions were often interrupted by the game misreading the board state or players inadvertently bumping the webcam pole. This moments of friction during the game sessions may have led to the slight disadvantage of the hybrid version in terms of ease of use.

Additionally, in both the digital and hybrid versions of the 4Ts Core Module, teachers found Level 1 of the game restrictive and frustrating, as the system attempted to correct each of their deviations from the codified techniques. While it should be noted that these evaluations came from in-service teachers – Level 1 of the game is perhaps more suited for teachers-in-training – allowing some deviations from the standard techniques, as long as they are logically consistent, may prevent user frustration. On the other hand, some teachers felt that Level 2 was too unguided, as it lacks technique cards altogether. Including technique cards in Level 2, even just for consultation purposes, may provide the scaffolding that teachers felt they still needed. Future research and more extensive validation experiments, especially involving the

hybrid version, are necessary to fully understand and optimise the game's effectiveness in the three formats.

Lastly, both the 4Ts Core Module and the SRL Module had a positive effect on teachers' learning outcomes, as well as their belief in the importance of promoting SRL in students (Persico, Passarelli, Manganello, & Pozzi, 2023). Importantly, after the proposed playing sessions, teachers seemed to internalize important design principles for SRL, such as fostering students to reflect on their learning processes, with specific emphasis on self-assessment strategies that help them to identify the causes of failures, and making sure they receive emotional support. These results appear to be more positive than those reported by Dignath-van Ewijk and Van der Werf (2012), whose survey of teachers' beliefs suggested that, in the absence of training, teachers seem to believe that providing room for choice to students is more important than helping them to reflect on ways to make informed choices.

Moreover, the gaming experience was reported as engaging and fun for both the 4Ts Core Module and the SRL Module. The competitive component of the SRL Module, especially, was reported as mild enough to foster social comparison without leading to cutthroat competition and negative emotions (Persico et al., 2023). These are all encouraging results, especially when considering the potential to use the SRL-4Ts game in a training context.

Overall, the preliminary results underscore the potential of the game in supporting teachers' professional development in collaborative LD, but also the need for refining the digital and hybrid versions.

3.5 Sustainability and transferability

Sustainability in teacher training tools hinges on their ability to remain relevant, functional, and effective over time, and, above all, easily usable in contexts with training constraints or limited resources. To this end, the SRL-4Ts game has been designed with the aim of maximising its viability and adaptability across different contexts in six ways: broad applicability of the theoretical foundation, availability of different playing modes, limited resource requirements, ease of modification, technical architecture, and localization.

These are briefly explained in the following:

- **Broad applicability of the theoretical foundation:** The 4Ts model underlying the 4Ts Core module provides a content-independent framework that can be used to design collaborative learning activities across different disciplines, educational levels, subject areas, and cultural contexts. Additionally, the model can be applied to design activities with any disciplinary and transversal aims and objectives, as long as the approach is collaborative in nature. Similarly, the Zimmerman-inspired principles used in the SRL Module are content-agnostic and can be applied, just like the 4Ts model, to a wide variety of contexts.
- **Availability of different playing modes:** Both modules of the game can be played in tangible, digital, or hybrid forms, making them adaptable to a wide range of educational environments, from well-equipped modern schools to those with limited digital resources, and from spaces with tight space/time constraints to those without such limitations. The hybrid version of the 4Ts Core module, which combines tangible components with digital feedback, is probably the most demanding to use in practice (as it requires space for setting up a table, hardware for running the digital component, and

sometimes fiddly calibration using a stick-supported webcam). However, when feasible, the hybrid mode combines the best features of the other two modes: face-to-face interaction, the tactility of game components, and automated feedback/suggestions without the friction inherent in a purely digital version.

- **Limited resource requirements:** We have ensured that the digital and hybrid versions of the game are completely free and have minimal hardware requirements. The 4Ts Core Module can run on low-spec laptops (as little as 8 GB of RAM), and the SRL module, being entirely Google Sheets-based, has even lower requirements than the Core Module, making it very easy to use the module fully digitally even in environments with very limited hardware and financial resources. Even the hybrid version of the 4Ts Core Module, which is the most complex implementation, requires no more than a laptop, a webcam, a stick, and some printed elements.
- **Ease of modification:** The content of the game, in both its digital and tangible forms, has been designed to be easily customizable and updatable. The 4Ts Core Module card content is listed in a Google Sheet that educators can modify, translate, or adapt without needing advanced technical skills. The digital version can be specified to retrieve card contents from any Google Sheet, while an online tool (https://out.openlab.com/pleiade/) can generate tangible cards with ArUco codes for the hybrid and tangible modes. Similarly, the contents of the cards of the SRL module can be easily customized. This feature not only extends the game's relevance across different linguistic and cultural settings but also enables continuous updates and improvements based on user feedback and future projects.
- **Technical architecture and Open Source availability:** The 4Ts Core Module's architecture supports its sustainability by employing a layered system with a decoupled knowledge base, al-

lowing for incremental enhancements without requiring a complete overhaul. This preserves the game's core functionalities while incorporating new features or addressing issues that arise. The digital component, built using widely-used programming languages and platforms (Unity and Prolog), ensure compatibility with technological standards. Additionally, both the 4Ts Core module, as well as the SRL-module, are free and Open Source, available at https://sites.itd.cnr.it/-4TsGame/#srl-4ts. This ensures that schools with limited financial resources can access the game, and experienced programmers can modify it or add features without limitations.

– **Language availability and localization:** Currently, the full game is available in English, while the 4Ts Core Module is also available in Bulgarian, Greek, and Italian. As card text is not embedded in game code, but dynamically retrieved from a Google Sheet, the software is predisposed for easy localisation and translation into other languages. It should be noted that the degree of flexibility provided by this implementation allows easy customisation of game content that goes beyond mere translation. For example, it opens the possibility of adapting card content to counter cultural barriers, by changing card text in order to adapt them to different cultural and practical contexts. In the same way, the prompts contained in the SRL module can be easily translated and customized.

References

Dignath-van Ewijk C., & van der Werf G. (2012). What teachers think about self-regulated learning: Investigating teacher beliefs and teacher behaviour of enhancing students' self-regulation. *Education Research International*, 2012, 741713. https://doi.org/10.1155/2012/741713

Paris S. G., & Paris A. H. (2001). Classroom applications of research on self-regulated learning. *Educational Psychologist, 36*(2), 89-101. https://doi.org/10.1207/S15326985EP3602_4

Peel K. L. (2020). Everyday classroom teaching practices for self-regulated learning. *Issues in Educational Research, 30*(1), 260-282. https://search.informit.org/doi/10.3316/informit.086252042580660

Pernin J.-P., Michau F., Mandran N., & Mariais C. (2011). ScenLRPG, a board game for the collaborative design of GBL scenarios: Qualitative analysis of an experiment. Retrieved from http://www.scenariopedagogique.net/site/IMG/pdf/ECGBL12_Pernin_et_al.pdf

Persico D., Manganello F., Passarelli M., & Pozzi F. (2023). Is GBL good for teachers? A game for teachers on how to foster students' self-regulated learning. *Education Sciences, 13*, 1180. https://-doi.org/10.3390/educsci13121180

Pozzi F., Ceregini A., Dagnino F. M., Persico D., Prieto L. P., & Sarti L. (2017). Designing collaborative learning activities with an augmented LD tool. In *2017 IEEE 17th International Conference on Advanced Learning Technologies (ICALT)* (pp. 207-209). https://-/doi.org/10.1109/ICALT.2017.87

Pozzi F., Ceregini A., Ivanov S., Passarelli M., Persico D., & Volta E. (2024). Digital vs. hybrid: Comparing two versions of a board game for teacher training. *Education Sciences, 14*, 318. https://doi.org/-10.3390/educsci14030318

Pozzi F., Ceregini A., Manganello F., Passarelli M., & Persico D. (2022). *The SRL-4Ts game user guide*. https://doi.org/10.17471/54018

Pozzi F., Ceregini A., & Persico D. (2015). "ProgeTTTTare" l'apprendimento collaborativo con 4T. *Italian Journal of Educational Technology, 66*(3), 23-31. https://ijet.itd.cnr.it/index.php/td/article/-view/813/731

Pozzi F., Ceregini A., & Persico D. (2016). Designing networked learning with 4Ts. In S. Cranmer, N. B. Dohn, M. de Laat, T. Ryberg, & J. A. Sime (Eds.), *Proceedings of the 10th International Conference on Networked Learning 2016*.

Pozzi F., Persico D., Passarelli M., Ceregini A., Polsinelli P., & Bicocchi M. (2022). Smartness dimensions in designing collaborative learning activities. In *MELECON 2022 - IEEE Mediterranean Electrotechnical Conference, Proceedings* (pp. 632-637). https://doi.org/10.1109/-MELECON.2022.9901319

Zimmerman B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist*, 25(1), 3-17. https://doi.org/10.1207/s15326985ep2501_2

Zimmerman B. J. (2002). Becoming a self-regulated learner: An overview. *Theory Into Practice, 41*(2), 64-70. https://doi.org/10.1207-/s15430421tip4102_2

Zumbrunn S., Tadlock J., & Roberts E. D. (2011). Encourage self-regulated learning in the classroom. *MERC Publications*. Retrieved from https://scholarscompass.vcu.edu/merc_pubs/18/

Chapter 4.
Design-Based Research: A methodological approach to the design and validation of the SuperRED components[1]

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4.1 The Design-Based Research approach

The overall research strategy adopted to achieve the SuperRED objectives, from the development of the framework (Chapter 2) to the implementation and testing of the educational scenarios (Chapter 6), is the Design-Based Research (DBR), a methodological approach to education design and research involving iterative cycles of analysis, design, development and implementation. The application of DBR in educational studies is extensively documented in the literature (Anderson & Shattuck, 2012; Fowler et al., 2023; Tinoca et al., 2022; Zheng, 2015). This body of work highlights the positive outcomes achieved in the educational context, both in terms of student learning and teacher competences. Furthermore, it underscores the significant potential of DBR to drive innovation in educational practices.

1 Although the chapter has been jointly conceived by the authors, Maria Ranieri wrote paragraphs 4.2, 4.5, 4.9, Alice Roffi paragraph 4.1, 4.3, 4.4, Gabriele Biagini paragraph 4.6, 4.7, 4.8.

DBR is based on the collaboration between practitioners and researchers in real contexts, following design principles and context-sensitive theories (Design-Based Research Collective, 2003), with the aim of producing practical, theory-informed solutions (Swan, 2014) to complex educational problems. From this perspective, it is crucial for DBR investigating the learning processes in the real context for enhancing the knowledge related to the design and implementation of innovative learning environments and developing design principles that guide, inform and improve the practice in the educational context (Design-Based Research Collective, 2003). At the same time, the investigation in real context requires a multidimensional view that in DBR is reflected in the use of various techniques and tools for the research evaluation. These characteristics of DBR, namely the choice of methods and the specific focus on real problems in educational contexts, are in line with the perspectives of American pragmatic philosophy, whose main exponents were initially Charles Sanders Peirce, John Dewey and William James and subsequently Abraham Kaplan and Richard Rorty (Anderson & Shattuck, 2012).

The final aim of DBR is to produce an effective design, an account of the theory and principles, and an analysis of the range of ways in which the design functions in the hands of a typical sample of the target population of teachers and students. This helps in understanding and adjusting the context and the intervention to maximize learning.

From this point of view, DBR share some similarities with other research approach, for example action research (Anderson & Shattuck, 2012), although they are different in the main purpose and also in the process: the main aspect in which the two approaches diverge is in the objective to be achieved, if for action research the main aim is to meet the needs of the context, the DBR not only takes local needs into consideration, but also aims to advance knowledge, "to uncover, explore, and confirm theoretical relationships" (Barab & Squire, 2004, p. 5). Another ele-

ment of discontinuity between DBR and action research is that usually in action research teachers carried out the research alone, thus not benefitting from the synergic collaboration with researchers, a main strength of DBR. In the literature, some researchers (Cole et al., 2005) suggest the possibility to improve the action research and DBR approaches, specifically adding a constructive phase in action research, aiming at constructing theories, artifacts, models or prototypes to promote the distribution of the results, and a reflective step to DBR. However, Anderson and Shattuck (2012) not completely agreed with this perspective, since they believed that, even if not explicitly reported, the reflection process permeates all phases in the DBR.

To translate the complexity of this methodological approach into a feasible procedure, Reeves (2006) suggested to articulate the DBR process in the following phases:

- Analysis of practical problems by researchers and practitioners: this initial phase involves identifying and defining the practical educational problems through collaboration between researchers and practitioners. The goal is to ensure that the research addresses real-world issues that are relevant to educational practice.
- Development of solutions informed by existing design principles and technological innovations: in this phase, researchers and practitioners work together to develop potential solutions based on existing theories, design principles, and technological advancements. The solutions are designed to be practical and applicable in real educational settings.
- Iterative cycles of testing and refinement of solutions in practice: this phase involves implementing the developed solutions in real educational contexts and systematically testing and refining them through multiple iterations. Feedback from these implementations is used to improve and adapt the solutions to better meet the needs of the educational environment.

- Reflection to produce design principles and enhance solution implementation: the final phase focuses on reflecting on the outcomes of the research to derive generalizable design principles and theories that can inform future practice and research. This phase also involves documenting and disseminating the findings to contribute to the broader educational knowledge base.

These phases illustrate the cyclical and collaborative nature of DBR, emphasizing the importance of practical relevance, iterative refinement, and the generation of theory-based solutions.

4.2 The Design-Based Research in the SuperRED project

In the SuperRED project, the DBR strategy was implemented at different stages and produced several results that are documented throughout this volume. Table 1 below summarizes how DBR was adapted and applied within the project, describing the SuperRED methodology according to the DBR phases and indicating where the outputs of each phase are presented in this book.

DBR strategy	DBR strategy in SuperRED	SuperRED Outputs in this book
DBR Phase 1 - Analysis of Practical Problems by researchers and practitioners (APP)	**DBR Phase 1** – Identification of the gaps in the theory and practice and definition of existing design principles	Literature review, teachers' survey, elaboration of guidelines (i.e. SuperRED framework) (Chapter 2)
DBR Phase 2 - Development of Solutions informed by existing design principles and technological innovations (DS)	**DBR Phase 2a** – First cycle of co-design based on SuperRED framework and 4Ts game guidelines	Co-design of eight educational scenarios in the different partner countries, based on the collaboration of researchers and teachers. The design approach and the educational scenarios are described in Chapter 4.
	DBR Phase 2b – Second cycle of co-design informed by the results first cycle of testing and refinement	Second co-design of eight educational scenarios based on the collaboration of researchers and teachers. The design approach and the educational scenarios are described in Chapter 4.
DBR Phase 3 - Iterative Cycles of Testing and Refinement of solutions in practice (ICTR)	**DBR Phase 3a** – First cycle of testing and refinement: evaluation of the solutions developed in DBR2a	Evaluation of the first co-design based on ad hoc tools developed by UNIFI. The research instruments are described in Chapter 4, while the results are reported in Chapter 6.
	DBR Phase 3b - Second cycle of testing and refinement: evaluation of the solutions developed in DBR2b	Evaluation of the second co-design based on ad hoc tools developed by UNIFI. The research instruments are described in Chapter 4, while the results are reported in Chapter 6.
DBR Phase 4 - Reflection to produce design principles and enhance solution implementation	**DBR Phase 4** – Final reflection on the SuperRED approach.	Final considerations on the SuperRED approach, particularly referring to its transferability (Chapter 6).

Table 1: The DBR approach in the SuperRED project – Tools and documentation

Following the articulation described in Table 1, the purpose of this chapter is to describe and explain how the DBR approach was adopted and adapted to the SuperRED objectives. The focus here is on the methodology which grounded the design and the refinement of the educational scenarios to generate meaningful solutions for the improvements of school digital readiness. Although the first step of DBR in SuperRED has already been presented in Chapter 2, to provide a consistent overview of the overall research design process we'll include in this presentation all the phases.

4.3 DBR Phase 1: Identification of the gaps in the theory and practice and definition of existing design principles

As anticipated, the first phase of the SuperRED approach to DBR was devoted to the building up of a comprehensive analysis of the problem, specifically focusing on Learning Design (LD) and Self-Regulated Learning (SRL) within digital and remote education settings. This analysis was executed through an extensive literature review and a detailed survey addressed to the teachers, as thoroughly discussed in Chapter 2.

The literature review was a collaborative effort among the research partners, aimed at identifying fundamental papers on LD and SRL, and examining them across three distinct perspectives, i.e. methods/models, tools/technologies, and Learning Ecologies (LE). The review spanned various educational settings such as remote, blended, and face-to-face learning, ensuring a holistic understanding of educational issues. The process provided the ground for the subsequent phase, aimed at producing a robust set of guidelines to support teachers in LD for students' SRL.

To complement the literature review, a comprehensive survey was conducted to gather insights directly from teachers regarding their knowledge, experiences, and needs related to LD and SRL.

The survey, involving 47 teachers from the SuperRED school partners, revealed significant challenges such as the lack of time and resources, and a pronounced need for enhanced support in LD. Additionally, it highlighted shifts in teaching practices during the lockdown period, with many educators adopting new technologies and strategies to boost interactivity and engagement. For instance, the survey's data indicated that many teachers had to reconceptualize their teaching practices through the integration of diverse digital tools and innovative teaching strategies for nurturing student engagement. This need led to the adoption of interactive platforms, graphic tools, and flipped classroom techniques, which allowed teachers to deliver significant lectures for the students during the periods of remote teaching. The survey also investigated teachers' familiarity with LD and SRL constructs, finding that a substantial number of teachers were already implementing aspects of these methodologies in their daily practices, despite facing considerable barriers.

Furthermore, the findings from the survey highlighted the different experiences and needs of the teachers. For example, while some educators were used to regularly employed LD tools, others lacked the confidence or the resources, even in terms of support, for doing it. This underlined the need for tailored professional development and resources to assist teachers in effectively adopting LD and SRL strategies. Teachers also expressed a need for more specific tools and models to be sustained in designing learning activities.

As a result of the literature review and the survey, the SuperRED framework provides guidance to design effective educational scenarios to facilitate students' SRL, while prompting teachers' competences in the area of LD across different educational settings: remote, blended, and face-to-face. The SuperRED framework is fully described in Chapter 2 together with the methodology and the results of the literature review, the survey and the validation process.

4.4 DBR Phase 2a – First cycle of co-design based on SuperRED framework and 4Ts game guidelines

The development phase in the SuperRED approach to DBR focused on creating effective solutions for enhancing LD and SRL among teachers and students. Building on the results of the previous phase, this phase mainly consisted in the involvement of teachers in the co-design of the educational scenarios to be tested in the schools of the partner countries, that is Belgium, Italy and Catalonia. The design principles at the ground of this developmental phase were included in the SuperRED framework, while the strategy for teachers' engagement in the co-design process was borrowed from the methodology of the 4Ts game (Chapter 3), an innovative tool designed by the ITD-CNR (Ceregini et al., 2019). This tool aims to support teachers in the conceptualisation phase of the LD process. The game serves as an instrument for teachers, facilitating the integration of theoretical knowledge with practical application in the classroom. By encouraging active participation and collaboration among educators, the 4Ts game helps foster a more dynamic and responsive learning environment. In the context of SuperRED, the 4Ts game was used to help teachers in the co-design of educational scenarios with a specific focus on SRL.

The SuperRED framework and the 4Ts game, together with an educational app specifically designed to address students' SRL, provided a comprehensive toolkit for educators involved in the project to navigate the complexities of digital and remote education. These resources supported the teachers in the design of effective learning strategies, leveraging digital tools, and fostering an environment conducive to SRL. They were introduced to the teachers involved in the project during the first LTTA (Learning, Teaching, Training, Activities), a training event which took place at the ITD-CNR in Genoa in November 2022. The main objective of the event was to share with the teachers the educational

and methodological tools to be used in the project, and to explain how to use the 4Ts game for the first co-design of the educational scenarios based on the SuperRED framework. Following this event, the teachers designed a first draft of the educational scenarios, which was validated by UNIFI in order to release the final version within the end of February 2023. At the end of this phase, eight educational scenarios were co-designed, of whom three from the Belgian team, three from the Italian team and two from the Spanish team. In Box 1, a summary of the educational scenarios designed and implemented is provided.

Box 1. SuperRED Educational scenarios – First cycle of co-design and testing

Belgium

Media Theories 101 and analysing your own media usage
This scenario focused on supporting students' learning of various media theories and the ability to connect these theories with real-world examples. Throughout this educational journey, students engaged in a combination of individual search and collaborative group work. They initially analysed different media theories through independent study, leveraging technological tools like Microsoft Teams and PowerPoint to support their search and learning. Following their individual exploration, the students worked together, first in pairs and then in larger groups, to discuss, refine, and present their understanding of these theories. The output of the activity was a comprehensive presentation where students synthesized all theories into a unified narrative, integrating feedback from peers and teachers.

Microsoft Excel
This scenario dealt with the basics of Excel as part of a broader ICT curriculum with the aim of promoting a

fundamental understanding of Microsoft Excel functions and features. The learning process involved a combination of individual documentation and collaborative exercises. Students utilized various resources, including materials provided by the teachers and online platforms like websites and YouTube, to build their initial understanding of the software. They, then, worked in pairs and small groups to discuss, consolidate, and enhance their knowledge, promoting peer learning and collaborative skills. The educational journey culminated in a plenary session, providing an opportunity for collective learning and clarification of concepts, under the guidance of the teacher.

Accentwerking
This scenario was characterized by a series of activities addressing gifted students, who were requested to select an extracurricular topic and explore it in depth. The selection of the specific subject matter was supported by the teacher, while the study was conducted autonomously. The students could devote their time to the task for a few hours a week under the guidance of a coach. At the end, they had to present their work/results to the entire school. The content to be explored varies from student to student. For example, some students focused on a new language, others organized an activity for a charitable cause, and yet others wrote a computer program. The search for material to prepare themselves conceptually was autonomously conducted to seek the best solution for solving the problems faced. Afterward, they collaboratively worked with other students to reach personal goals.

Italy

Meet the scientist
This scenario concentrated on the valorization of scientific heritage through the knowledge of some extraordinary scientists, who have distinguished themselves in his

field, marking epochal turning points in the history of science, thought and society. Based on the use of new technologies and innovative and inclusive teaching tools, students were actively involved in group work to engage in a debate, where they had to identify with great historical scientists (Newton, Galilei, Marie Curie, Edward Jenner, Tim Berners-Lee). To win the debate, students had to search for and critically analyze online resources, use graphic software (Google Presentations or Canva) to produce content useful for the competition. Finally they had to argue their thesis by using effective communication strategies to support some of the most significant personalities of the national and international scientific culture, both from the past and the present.

Acquiring knowledge *from the environment around us (Traveling from Rome to the Constitution)*
This scenario centered on the exploration of the historical and institutional importance of Rome's landmark buildings and the Italian Constitution. After an instructional visit to Rome, students from two classes were involved in activities aimed to create a digital guide, while encouraging them to develop digital competences, team collaboration, and knowledge of civic institutions. The students were divided into groups, each one dedicated to a research work about one of the institutional buildings visited in Rome. The material was then produced in digital format (one for each class) and the material collected was reworked to create a shared storyboard.

Stay safe on the net
This scenario revolved around cyberbullying and online safety, encouraging students to search, collaborate, and create digital presentations or artifacts that reflect their understanding of safe on-linepractices. Across these activities, students were supported in developing SRL skills, including goal setting, strategic planning, and emotional support. Collaborative techniques were employed to en-

hance engagement and peer learning. Each group deepened their knowledge of one of the problems that can be met in online contexts through the use of material proposed by the teachers and by themselves. The students were invited to reflect on the most suitable behaviour to adopt to prevent each individual problem. At the end of this phase each group proposed a digital presentation of their findings, developing an artifact of their own choice to be illustrated in the plenary.

Catalonia

Are all euro coins made of the same alloy?
This scenario focused on the scientific investigation of euro coins, involving students in a practical exploration of density, materials, and buoyancy. Set in both classroom and laboratory environments, it combined hands-on experiments with digital search of resources. Students worked collaboratively in small groups, first studying the properties of different euro coins and then conducting lab measurements and internet search to determine if the coins were made of the same alloy. They compared the different results and shared the small groups' conclusions with the entire class. The whole group were invited to discuss the accuracy of their measures, the acceptance of error and the reliability of the information found.

Art alive
This scenario centered on the world of Baroque art. This classroom-based project stimulated students to analyze and interpret significant Baroque artworks, on composition, use of light, color, and historical context. Through individual investigation, followed by group collaboration, students prepared and presented their findings, gaining insights into the cultural and societal influences of the Baroque period. Students were involved in the first individual search activity to find information about a significant Baroque artwork. Each one had a different work but

all of them focused on a key feature (i.e., composition, use of light, etc.) to be analysed. After that they gathered in expert groups and prepared a presentation to provide a general overview of the Baroque era. Finally, the students working on the same artwork shared the different perspectives of their investigation. Then each group presented their analysis to the class, highlighting their interpretation and discussing the unique elements of every artwork.

4.5 DBR Phase 3a – First cycle of testing and refinement: evaluation of the solutions developed in DBR2a

The first cycle of testing and refinement of the SuperRED approach was conducted across different national contexts as a first pilot of the educational scenarios that were implemented according to the unique characteristics and challenges of each partner country. The first implementation, with the support of the research teams, was carried out during the period March - May 2023 in the three partner schools that is: Bernardusscholen, Oudenaarde, Belgium (Bernardus); Istituto Comprensivo Sarzana, Sarzana, Italy (ISA13); Escola Solc, Barcelona, Catalonia (ESolc).

The evaluation was guided by three intertwined research questions and brought to the identification of opportunities and issues that were analysed to refine the educational scenarios and undertake the second cycle of implementation. To answer the research questions appropriate data collection tools were developed, while both quantitative and qualitative analyses were conducted to examine the data gathered. In the following sections, the research questions and tools are presented while the results of the study are reported in Chapter 6.

4.5.1 *Research questions of the first cycle of testing*

As already observed, the first evaluation phase aimed at assessing the effectiveness of the SuperRED approach in supporting teachers' development of LD skills and students' SRL abilities. More specifically, the three research questions (RQ) that have been explored during the first cycle of testing were:

– RQ1: Has the SuperRED approach (i.e., co-design of educational scenarios through the use of LD tools and grounding on the SuperRED framework) been effective and relevant in promoting teachers' LD skills in terms of professional development?
– RQ2: Has the educational scenario based on the SuperRED approach (i.e. co-design of educational scenarios through the use of LD tools and grounding on the SuperRED framework) been effective in promoting students' SRL skills, particularly referring to forethought, performance and self-reflection phases of SRL?
– RQ3: If and to what extent the proposed approach (co-design of educational scenarios, including the forethought, performance and self-reflection phases of SRL, using LD tools and grounding on the SuperRED framework) produced an impact on students learning results, suggesting the effectiveness of teachers LD?

4.5.2 *Data collection tools*

To answer the research questions of the first pilot *ad hoc* tools were developed, as described below (see also Table 1):

• A students' pre-survey (national language) to be delivered before starting the classroom activities and a students' post-sur-

vey (national language) to be carried out at the end. Both surveys aimed at exploring students' understanding of self-regulated processes associated with teaching and learning. They included both closed and open questions. In particular, they were structured in three sections: 1) General Information (Age, Gender, School level, Country), 2) the SRL section for understanding the level of students' awareness about SRL before and at the end of the educational experience, and 3) a final section to collect students' satisfaction about the activities carried out.

- A teachers' post-survey (national language) to be answered at the end of the intervention, with the aim of exploring teachers' understanding of LD and SRL. The survey includes both closed and open questions. It was structured in 3 sections: 1) General Information (Age, Gender, Professional qualification, School level and subject area), 2) the LD section for collecting teachers' perceptions about their LD skills, and 3) the SRL section for investigating what SRL skills the teachers supported during the first implementation.
- An observation grid (national language, optional) for the researcher to take notes on collaborative processes and teachers' use of SRL prompts; the key areas of observational activities usually pertain to the physical setting, the teacher behaviour, the conversations heard, and the contextual information. As a result, the grid was structured in three sections: 1) Physical Setting of the classroom (arrangement of the equipments, positive and critical aspects related to the setting of the classroom); 2) Collaborative learning, based on a well-known framework for collaborative learning, that is the model of Community of Inquiry (Garrison, Anderson, Archer, 2000); and 3) SRL prompts, that were observed by researchers during the teaching and learning activities in accordance with the Zimmermann's SRL model (see Chapter 1). Focusing on the second section, collaborative processes were observed through the lens

of the three types of presence highlighted by Garrison et al. (2000) within a community of inquiry, that is social presence, teaching presence, and cognitive presence. Therefore, information was collected about 1) the ability of learners to project their personal characteristics into the community and feel emotionally connected to one another (social presence); 2) the ability of teachers and group members to design, facilitate, and direct cognitive and social processes for the purpose of realizing personally meaningful and educational worthwhile learning outcomes (teaching presence); and 3) the extent to which the participants in any particular configuration of a community of inquiry are able to construct meaning through sustained communication (cognitive presence). However, the observation tool was applied only in one class of the Italian context.

Research Questions	Type of Data	Research methods & Tools	Time
RQ1: Has the SuperRED approach (i.e., co-design of learning scenarios through the use of LD tools and grounding on the SuperRED framework) been effective and relevant in promoting teachers' LD skills in terms of professional development?	Teachers' perceptions of their LD skills and the implementation of the learning scenario (i.e.Did everything go as planned? Would they change anything?)	Teachers' survey (Self-reported questionnaire based on self-assessment)	Ex-post

RQ2: Has the learning scenario based on the SuperRED approach (i.e. co-design of learning scenarios through the use of LD tools and grounding on the SuperRED framework) been effective in promoting students' SRL skills, particularly referring to forethought, performance and self-reflection phases of SRL?	Students' perception of the SRL skills (including the forethought, performance and self- reflection phases)	Students' survey (Self-reported questionnaire based on self-assessment)	Ex-ante Ex-post
	Researcher's notes on physical setting, teacher/students' behaviours, and contextual information	Observation grid	In itinere
	Teachers' perceptions on their capacity to support students' SRL through the learning scenario (including the forethought, performance and self- reflection phases)	Teachers' survey (Self-reported questionnaire based on self-assessment)	Ex-post
RQ3: If and to what extent the proposed approach (co-design of educational scenarios, that they take into account the SRL dimension of forethought, performance and self-reflection, through the use of a LD tools for collaborative activities design and the SuperRED framework for LD and SRL) produced an impact on students learning results, and consequently on the effectiveness of the teachers learning design?	Researcher's notes on physical setting, teacher/students' behaviours, and contextual information	Observation grid	In itinere
	Students' perceptions of the effectiveness of the learning scenario. (e.g. How much do you think your knowledge of the topic x has improved following the training activities)	Students' survey (Self-reported questionnaire based on self-assessment)	Ex Post

Table 2: The research strategy to evaluate the first cycle of testing

4.5.3 *Data analysis*

The analytical procedure was designed to analyze and group data (qualitative and quantitative) for assessing the impact of the SuperRED approach, specifically LD and SRL, on students and teachers. This involved a systematic process, including three steps, to ensure comprehensive data analysis and triangulation.

- The first step focused on defining and categorizing the dimensions for evaluation. For LD, three key dimensions were identified: 1) Conceptualisation of the design idea, 2) Planning and authoring, and 3) Implementation of the resulting design and enactment with learners. The "conceptualisation of the design idea" involves defining learning objectives, identifying relevant content areas, and selecting appropriate pedagogical strategies. "Planning and authoring" encompasses the association of educational resources and tools for learners, while "Implementation of the resulting design and enactment with learners" includes differentiated activities and the potential of design features to develop students' SRL skills. Similarly, for SRL, three phases were delineated: 1) Forethought, 2) Performance, and 3) Self-Reflection. The "Forethought" phase pertains to processes and beliefs preceding learning efforts, including content identification and strategy selection. The "Performance" phase covers processes during the learning efforts, and the "Self-Reflection" phase involves reflective processes post-learning efforts.
- The second step, data reduction, involved aggregating the items from various data collection tools (i.e., pre- and post-surveys for students and teachers and observation grids) according to the identified dimensions. Utilizing a Likert scale (1-5) facilitated this process, allowing the calculation of mean scores for items impacting specific dimensions. This enabled a concise summary of the data. The qualitative data of the ob-

servation grid were analysed according to the thematic analysis (Braun & Clarke, 2006), following a deductive approach, thus the thematic analysis is driven by the researcher's theoretical or analytical interests in the area (analyst-driven). This analysis was supported by QCAmap (Mayring, 2021), an open access web application for systematic text analysis based on the techniques of qualitative content analysis.

- The third step, data triangulation, was crucial for ensuring the validity and reliability of the findings. It involved two main aspects. First, we triangulated the data collected from various tools (i.e., pre- and post-surveys for students and teachers, and observation grids) against the dimensions identified for both LD and SRL. This was done to gather multiple sources of data on the same dimension, providing a comprehensive view. Specifically, we calculated the average of the means derived from these different sources to get a more accurate measure of each dimension. By doing so, we ensured that the data from different tools converged to provide a reliable assessment of each dimension. Second, we cross-referenced data from different target groups to confirm the perceptions that emerged. For instance, we used the students' learning results to verify the effectiveness of the teachers' LD. This cross-target data comparison allowed us to corroborate the findings from one group with evidence from another, thus strengthening the overall validity of the results. This approach not only confirmed the teachers' perceptions of their LD but also provided tangible evidence of their impact on students' learning outcomes. To facilitate the data triangulation, a triangulation grid was used. This grid grouped the reduced data by specific dimensions and identified subcategories or emerging categories within each dimension. This structured approach allowed for a detailed analysis of each dimension, considering both the triangulated quantitative data and the coded qualitative data. The final analysis provided a comprehensive interpretation and ex-

planation, ensuring that the findings were well-supported by multiple data sources and perspectives.

In summary, the methodology of data collection and analysis was based on a comprehensive framework for data reduction and display, tailored to the project's specific research questions. This architecture facilitated the analysis of both quantitative and qualitative data, ensuring a thorough evaluation of the impact of the SuperRED approach on LD and SRL skills among students and teachers. By triangulating data from various tools and cross-referencing different target groups, we ensured the robustness and reliability of our findings that are presented and discussed in Chapter 6.

4.5.4 *Refinement of co-desing*

Following the first evaluation phase, a refinement was implemented to further develop and improve the SuperRED approach based on feedback and data collected. This phase aimed to enhance the practical applicability and effectiveness of the SuperRED framework to prepare the second evaluation phase. The refinement was conducted in three steps:

- Step 1: the critical issues faced by teachers in the first cycle of co-design-testing were collected, associated with specific improvement action(s). These actions were related to possible improvements in the phases of the co-design or during the implementation. Also, changes in some elements of the testing design (such as modification in evaluation tools) were considered.
- Step 2: after the development of the first draft of the improvement plan for the second cycle of testing, an online meeting was held to discuss the changes with researchers and teachers, collecting their feedback.

– Step 3: finally, the finalized version of the improvement actions was translated into guidelines to be inserted in the update version of the framework.

The results of the refinement are fully documented later in Chapter 6, which – as already noted – includes the presentations and the discussion of all the project's findings.

4.6 DBR Phase 2b – Second cycle of co-design informed by the results first cycle of testing and refinement

The second cycle of co-design of educational scenarios for the second testing phase was performed during the second LTTA, hosted by Bernardusscholen in Oudenaarde in October 2023. This training event focused on the use of the SuperRED app to be used for supporting students' SRL during the scenario's implementation. The teachers were trained about the app's main functionalities and goals. The app was conceived according to the Zimmermann model of SRL (see Chapter 1), including functionalities inspired to the three 3 phases of *Forethought*, *Performance*, *Reflection*: the app allows students to set individual goals, to manage tasks and progress, and to reflect on their learning activities (for detailed information about SuperRED app theoretical foundation and characteristics, see Chapter 5).

Following this event, teachers designed a first draft of the educational scenarios that were validated by UNIFI to release the final version by March 2024. At the end of this phase, seven educational scenarios were co-designed, of whom three from the Belgian team, two from the Italian team and two from the Spanish team. In Box 2, a summary of the educational scenarios designed and implemented is provided.

Box 2. SuperRED Educational scenarios – Second cycle of co-design and testing

Belgium

Electricity: difference between series and parallel circuits
The first scenario focused on the electric circuits, starting from what learnt in the previous trimester about the components of an electrical circuit, and moving forward to discover that multiple components can be connected in different ways, leading to different effects. Each group of students investigated a type of circuit. In turn, they shared their research with the rest of the class, so that by the end of the project, the class had a comprehensive understanding of the proposed topic.

Formatting in Word
The second scenario focused on formatting a Word document. The class was divided into 3 groups, assigning them a type of format (such as character formatting, paragraph formatting and page formatting). Initially the students worked independently and then discussed in their group what difficulties they have encountered and how to apply the type of formatting most efficiently. After this was done, the groups were mixed, and the students shared their acquired knowledge with the other groups.

Interview another student
The third scenario focused on improving English speaking skills. In general, students' comprehension skills were generally well-developed, thanks to a year of dedicated English study and exposure to abundant English content through various mediums such as the internet, television, and social media. However, despite their familiarity with the language, a notable challenge emerges when it comes to articulating well-structured and insi-

ghtful responses. The activities were oriented to speaking, writing and the general increase of their English vocabulary. By means of peer review, the students thought about possible mistakes which have been made and how to prevent them in the future.

Italy

Ilaria Alpi: an example of courage and determination
In the context of the thirtieth anniversary of the journalist's Ilaria Alpi death, the scenario involved students in collaborative activities to discover Ilaria Alpi, underlying the values that her life can transmit to the younger generations. In particular, students planned and performed an interview for the writer that published a book for children about Ilaria Alpi, documenting it with a video. The objective of this activity was to promote in students a deep and conscious civic sense regarding respect for difficult realities far from ours, indignation for injustices and atrocities, love for what one does, for knowledge, for culture.

Masterchef for a day
This scenario focused on the eating habits of the main European countries and involved students in a collaborative creation of a typical European dish, also proposed through a digital presentation in English.The aim of the project is to improve communication (in English) and relational skills and abilities and to contribute to dealing with any new situations using innovative methodologies and strategies aimed at spreading greater well-being at school.

Catalonia

Where are the women?
This scenario focused on preparing for an art exhibition inspired by women artists on the occasion of the 8th March, for International Women Day. It was conceived

as a cross-class activity, involving students from 4th ESO working with students of 3rd and 4th primary. Students worked in groups to create a collaborative art piece inspired by the works of Hilma af Klint, Miriam Shapiro, Judy Chicago, Paula Modersohn-Becker and Frida Kahlo.

Destination UK
In the context of the exchange school from London, the activity of this scenario aimed at enhancing students' knowledge about the country as well as the city they are about to visit. An imaginary visit to the country with Olivia, a student who has to spend a gap year working in the UK to improve her English, has been planned. The class helped her to visit London as one of the highlights of her stay. The final product was a brochure and a presentation of the destination chosen for Olivia that should offer a mix of cultural, educational, and recreational opportunities for her as well as a good cultural background and places to visit.

4.7 DBR Phase 3b - Second cycle of testing and refinement: evaluation of the solutions developed in DBR2b

The second cycle of testing and refinement of the SuperRED approach was conducted during the period April - June 2024 in the three partner schools (ESolc, ISA13, Bernardus) with the support of the research teams.

The evaluation was guided by three research questions that partially correspond to the research questions of the first cycle of testing. Indeed, while the general focus was on measuring the effectiveness of the SuperRED approach, the specific research questions were reformulated on the basis of the results of the refinement phase and taking into account that the second cycle

of co-design planned the integration of the educational app within the educational scenarios. Similarly to the previous section devoted to the evaluation phase, in the following sections, the research questions and tools are presented while the results of the study are reported in Chapter 6.

4.7.1 *Research questions of the second cycle of testing*

As anticipated, the second evaluation phase focused on assessing the efficacy of the SuperRED approach in enhancing teachers' development of Learning Design (LD) skills and students' Self-Regulated Learning (SRL) abilities. Specifically, the three research questions (RQs) investigated during the second cycle of testing were:

- RQ1: Has the SuperRED approach (i.e., co-design of educational scenarios through the use of LD tools and grounding on the SuperRED framework) been effective and relevant in promoting teachers' LD skills in terms of professional development?
- RQ2: Has the educational scenario based on the SuperRED approach (i.e. co-design of educational scenarios through the use of LD tools and grounding on the SuperRED framework, and the use of SuperRED educational app for SRL) been effective in promoting students' SRL skills, particularly referring to forethought, performance and self-reflection phases of SRL?
- RQ3: If and to what extent the SuperRED approach (i.e. co-design of educational scenarios through the use of LD tools and grounding on the SuperRED framework, and the use of SuperRED educational app for SRL) produced further impact on students' skills and knowledge, suggesting the effectiveness of teachers' LD?

4.7.2 *Data collection and analysis*

The educational scenarios co-designed in the second cycle of DBR were implemented and tested in a real context, according to the same testing design of the first cycle and using a similar data collection tool (see above paragraph 5.4.2). In particular, based on the refinement phase, the instruments used for the first evaluation of the learning scenarios were slightly changed; the list of tools together the revisions made are described below:

- A students' pre-survey (national language) to be carried out before starting the classroom activities and a students' post-survey (national language) to be delivered at the end. These tools were provided in a simplified version to meet the students' difficulties in understanding the questions.
- A teachers' post-survey (national language) to be answered at the end of the activity to explore teachers' understanding of LD and SRL associated with teaching and learning. This tool included all the sections of the previous version and was expanded with some questions regarding the SuperRED educational app.
- An observation grid (national language, optional) for the researcher to take notes on collaborative activities and teachers' use of SRL prompts, the same used for the first testing phase.

4.8 DBR Phase 4 – Final reflection on the SuperRED approach

The final reflection on the SuperRED approach was conducted into two main steps. The first step consisted in an open discussion held with the main stakeholders (teachers, headmasters, policy makers) to evaluate the validity and transferability of the SuperRED approach. In this regard, during the last LTTA event in Barcelona (July, 2024), an online round table with teachers, head-

masters and policy makers was organized. After the online discussion, a questionnaire was sent to the participants, asking them their opinions on SuperRED methods and tools. The questionnaire was structured into 3 main sections: Strengths and Weaknesses, asking to provide specific examples for each strength and weakness; Enabling and Inhibiting Conditions for Transferability, to highlight the conditions that can hinder or facilitate the SuperRED approach applications in different contexts; Suggestions for improvements, to collect stakeholders suggestions to enhance the projects' results.

The second step was based on the integration of the positive and critical aspects emerged from the second cycle of testing and the stakeholders' comments (Step 1), translating them into specific improvements in the SuperRED approach, as modification of the framework or revision of tools integration into the practice.

The final considerations on the SuperRED approach are presented and discussed in Chapter 6.

4.9 Conclusion

This chapter focused on the research methodology adopted within the SuperRED project to design, develop and validate its theoretical and methodological components in relation to the themes of LD and SRL to enhance teachers and students experiences in the new digital educational context. The methodological approach was based on DBR, which is presented in the chapter firstly as a general research strategy and subsequently as it has been contextualized with the SuperRED project. One of the strengths of this methodological approach relies on its interest in real educational settings, allowing practitioners and researchers to gather significant results for practice improvement and to reinforce their cooperation. In the SuperRED project, the latter was

realized throughout the entire duration of the project and is documented in the different sections of this book. Another strength of DBR is related to the iterative process of designing, implementing and testing: since the educational interventions are rarely managed to be designed and implemented perfectly, the possibility for improvement is crucial both in terms of design and evaluation. In SuperRED these characteristics facilitated the promotion of teachers' LD skills and students' SRL through the different cycles of design, testing and refinement in the real context, leading to the improvement of teachers practice and students' learning processes.

Reference

Anderson, T., & Shattuck, J. (2012). Design-Based Research: A Decade of Progress in Education Research? *Educational Researcher*, *41*(1), 16–25. https://doi.org/10.3102/0013189X11428813.

Barab, S., & Squire, K. (2004). Design-Based Research: Putting a Stake in the Ground. In *Design-based Research*. Psychology Press.

Ceregini, A., Persico, D., Pozzi, F., & Sarti, L. (2019). The 4Ts Game to Develop Teachers' Competences for the Design of Collaborative Learning. In D. Burgos et al. (Eds.), *HELMeTO 2019, CCIS 1091*, pp. 192-205.

Cole, R., Purao, S., Rossi, M., & Sein, M. (2005). Being proactive: Where action research meets design research. *ICIS 2005 proceedings*, 27.

Design-Based Research Collective. (2003). Design-Based Research: An Emerging Paradigm for Educational Inquiry. *Educational Researcher*, 32(1), 5–8. https://doi.org/10.3102/0013189X032001005

Fowler, S., Cutting, C., Fiedler, S. H. D., & Leonard, S. N. (2023). Design-based research in mathematics education: Trends, challenges and potential. *Mathematics Education Research Journal*, 35(3), 635–658. https://doi.org/10.1007/s13394-021-00407-5.

Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical inquiry

in a text-based environment: Computer conferencing in higher education. *The internet and higher education*, 2(2-3), 87-105.

Reeves, T. (2006). Design research from a technology perspective. In *Educational Design Research*. Routledge.

Swan, M. (2014). Design research in mathematics education. *Encyclopedia of mathematics education*, 1, 148-152.

Tinoca, L., Piedade, J., Santos, S., Pedro, A., & Gomes, S. (2022). Design-based research in the educational field: A systematic literature review. *Education sciences*, 12(6), 410.

Zheng, L. (2015). A systematic literature review of design-based research from 2004 to 2013. *Journal of Computers in Education*, 2(4), 399-420. https://doi.org/10.1007/s40692-015-0036-z

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of educational psychology*, 81(3), 329.

Chapter 5.
Design and development of an educational app addressing students' self-regulated learning

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5.1 Introduction

Self-regulated learning (SRL) is increasingly recognized as a critical competence for learners in the 21st century. As education evolves in response to rapid technological and societal changes, it is imperative that students are equipped with effective strategies to manage and regulate their own learning and development throughout their lives. The ability to self-regulate has been linked to higher academic achievements, greater motivation, and enhanced overall learning outcomes (Broadbent & Poon, 2015; Pintrich & De Groot, 1990). Despite its importance, many students across different age groups struggle with SRL, either because they have not yet developed the necessary skills or because they find these strategies challenging to apply. Research suggests that students often fail to accurately monitor their own learning processes, leading to difficulties in making informed decisions about how to regulate their further learning activities (Bjork et al., 2013).

The development of SRL skills becomes even more critical in

digital and remote educational settings. In these contexts, students often lose the direct motivational and regulatory support typically provided by teachers in face-to-face interactions, making it harder for them to stay on track (Fournier & Durand, 2014). This challenge is particularly pronounced in online learning environments, where students are often required to operate with a high degree of autonomy. Without the immediate presence of a teacher to guide and support them, the ability to effectively manage and regulate their own learning processes becomes not just a beneficial skill but a necessary one.

TU Delft is charged to design and implement an educational app for students allowing them to better self-regulate their learning processes. Mobile technologies present distinctive opportunities for learning and monitoring progress, as smartphones serve as a constant, direct channel to learners, being the only technology that students carry with them at all times (van Merriënboer et al., 2002). It is therefore essential to provide learners with timely, relevant information. Additionally, mobile technologies are well-suited to tracking personal activities and monitoring progress toward individual goals, which can positively impact learners (Tabuenca et al., 2015). By utilizing learning analytics, we can assist learners in monitoring their progress and making informed decisions. Furthermore, the app can provide teachers with dashboards displaying students' progress and activities, thereby enabling them to better support students in their self-regulation efforts through co-regulation.

Previous research utilizing SRL related mobile applications has demonstrated positive effects on enhancing students' SRL skills and motivation (Baars et al., 2022; Breitwieser et al., 2023; Broadbent et al., 2020; Tabuenca et al., 2015). However, these studies are relatively few in number and have predominantly focused on daily diaries, learning strategies, or specific learning scenarios, which did not fully support the development of comprehensive SRL skills. Additionally, much of the existing re-

search has primarily targeted university students, leaving a gap in tools designed for younger learners.

The GoaLearn app aims to address these limitations by supporting students aged 10-15 in developing general SRL skills across various school subjects, such as language learning and mathematics. This app is designed to be applicable in different educational contexts and will be available in the national languages of the students, with the potential for easy adaptation to other languages. An innovative aspect of the GoaLearn app is its ability to collect research data and present it back to learners and teachers in a way that facilitates the regulation of the learning process, all while addressing privacy concerns. This feature is expected to greatly benefit both learners and educators by providing actionable insights into the learning process. By offering a more accessible and comprehensive tool for SRL, the GoaLearn app has the potential to make a significant impact on the learning outcomes of students worldwide.

5.2 Theoretical Model Underpinning the App

As the theoretical foundation for the app's design, we have chosen to rely on Zimmerman's model for SRL. This model, which has been empirically validated and is both straightforward and practical for implementation, serves as a robust framework for guiding the development of the GoaLearn app (Zimmerman & Campillo, 2003). The model was thoroughly introduced in Chapter 1, providing a comprehensive overview of its components and significance. Here, we will delve into the specific ways in which the Zimmerman model has informed and shaped the design of the GoaLearn app.

SRL, as defined by Zimmerman, refers to the extent to which individuals are "metacognitively and behaviourally active participants in their own learning" (Zimmerman, 1989). This concep-

tualization of SRL emphasizes the active role that learners must play in their educational processes, highlighting the importance of self-awareness, strategy use, and continuous monitoring of one's own progress. SRL is a social cognitive process that is structured around three cyclical phases: forethought, performance, and self-reflection.

In the *Forethought phase,* learners engage in the initial task analysis, which involves understanding the learning objectives and the requirements of the task at hand. During this phase, students set specific goals and develop a strategic plan to achieve those goals. This planning process is critical, as it lays the groundwork for effective learning and ensures that students have a clear roadmap to follow. In this phase, students also engage in a critical assessment of their self-motivation, providing a comprehensive overview of their self-efficacy, expected outcomes, and intrinsic interest in the goal. This evaluation helps students to not only measure their current levels of motivation but also to understand the underlying factors that contribute to their drive to succeed.

The *Performance phase* involves the actual execution of the learning task. During this phase, students apply the strategies they have selected, actively engage with the material, and continuously monitor their progress. This phase is characterized by a high level of cognitive engagement and the use of self-monitoring techniques to ensure that the learning process remains on track.

Finally, the *Self-Reflection phase* provides an opportunity for students to evaluate the outcomes of their efforts. In this phase, learners assess their performance, reflect on the effectiveness of the strategies they employed, and judge their overall satisfaction with the learning experience. This reflective process is crucial for identifying areas of improvement and making adjustments to future learning strategies.

By guiding students through these phases, the Zimmerman model encourages them to take an active role in their learning journey. Through the GoaLearn app, we aim to translate these

theoretical concepts into practical tools and features that support students in setting goals, planning their studies, using effective learning strategies, and evaluating their progress. The app is designed to facilitate this cyclical process of forethought, performance, and self-reflection, ultimately empowering students to become more effective, self-regulated learners.

5.3 The GoaLearn App

The GoaLearn app is web-based and has a flexible interface scheme to adapt to mobile devices. This application has been developed utilizing a Python-based technology stack, specifically employing the Django framework, which is integrated with a MySQL database to handle its data management needs. It has been engineered to operate online in production mode, a configuration that guarantees consistent availability and functionality. This is particularly beneficial for younger users, as well as those who may have limited experience with similar technologies. It is important to note that the app's source code is planned to be released as open-source software, which will occur once the full suite of intended features has been thoroughly implemented and successfully deployed. The welcome page of the app is shown in Fig. 1.

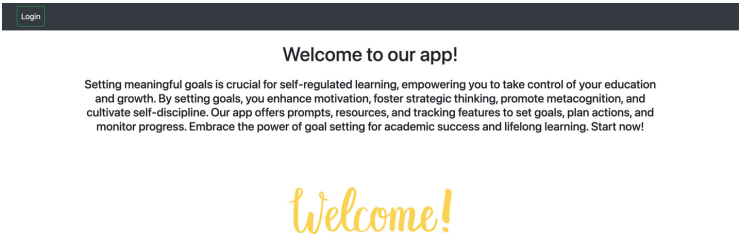

Fig. 1. Welcome page of the GoaLearn app

5.3.1 *Different Application Scopes*

The application offers different levels of content accessibility based on user roles, including Student, Teacher, Support, and Admin.

Students serve as the primary users of the app. Their interaction with the app involves planning and setting personal goals, carrying out tasks aimed at achieving those goals, and regularly reflecting on their progress. This continuous engagement with the app is designed to support their development and help them stay focused on their objectives.

Teacher accounts are designed to offer a range of additional features that cater specifically to the needs of educators. These features include the ability to create student accounts in batches, which streamlines the process of setting up multiple accounts simultaneously. Teachers can also create classes within the app, complete with the unique enrollment codes that facilitate easy student registration and organization. Moreover, the app enables teachers to create goal templates, allowing for the standardized setting of goals across different classes or group of students.

Support accounts can be registered on a school-by-school basis, allowing each institution to manage its own teachers effectively. Individuals with support accounts manage the approval process for new teacher registrations, ensuring that the requests and issues are addressed in a timely and organized manner.

Admin accounts are tasked with overseeing the export of aggregated data. Furthermore, they are responsible for approving new support account requests, ensuring that the app operates within a controlled and secure environment.

5.3.2 *Goals and Tasks*

The app's core features revolve around goals and tasks. These elements are central to the user experience, as they provide the framework for students to set goals and engage in activities that drive progress toward those goals.

5.3.2.1 *Goals*

Goals function as personalized metrics designed to assess the effectiveness of goal-setting and strategic planning within a designated timeframe. Each goal is composed of several key elements: a title that succinctly identifies the objective, a description that elaborates on the purpose and scope of the goal, and specified start and end dates that define the period during which the goal is intended to be pursued. Additionally, each goal may include useful links to external resources or references that support the achievement of the goal (see Fig. 2).

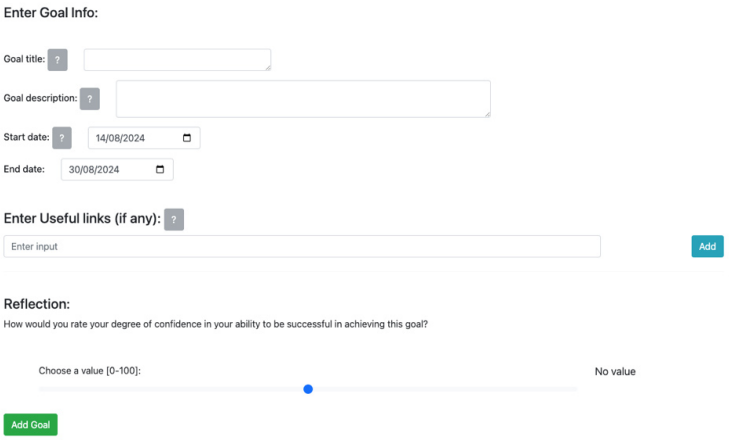

Fig. 2. Screenshot of goal creation page

Prompts play an important role in guiding users through the process of entering goal information. By clicking the question mark next to each element, users receive targeted prompts. For goal title, users read '*Think about your next two weeks. Think about a skill or subject that you want to improve. Pick a goal that is challenging for you but that you can achieve. Describe your goal in a single sentence.*' For goal description, users read '*Think about specific skills or knowledge areas that you want to improve. Think about measurable indicators of this goal, so that you can monitor your progress. Think about why this goal is important to your academic growth and personal interests. Make a detailed description of this goal.*' And for useful links, users read '*Think about what resources, support, or strategies you can utilize to help you reach this goal. For example, if your goal is to improve your math skills, you can add a link to a website where you practice math.*'

Goals can be created either individually by the user or through the use of templates provided by teachers. When creating personal goals, users have the flexibility to define and customize each goal according to their specific needs and aspirations. Once created, these personal goals are saved and prominently displayed on the goal dashboard, a centralized interface designed to facilitate effective goal management (see Fig. 3). Templates allow users to pre-fill goal information, significantly simplifying the goal-setting process. By copying these template goals, users can quickly establish objectives that align with academic or personal development standards set by teachers.

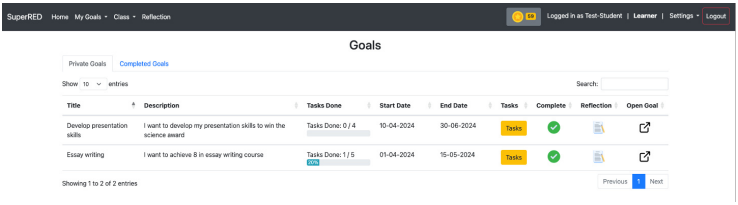

Fig. 3. Screenshot of the goal dashboard

The goal dashboard serves as a comprehensive platform for overseeing all aspects of goal management. It allows users to not only create goals but also to review, edit, delete, and mark them as completed. To enhance user experience and efficiency, the dashboard includes advanced features for sorting, filtering, and searching through goals. These features ensure that users can easily organize and navigate their goals, which are presented in an interactive table format. This layout is designed to provide a clear and accessible overview of all goals, enabling users to monitor their progress and make adjustments as needed.

5.3.2.2 Tasks

Each task is associated with a specific goal, which aids in organizing and managing progress toward that goal. When users create a task, they are required to provide detailed information, including a title, a description, and start and end dates (see Fig. 4). Additionally, users assign a weight to the task, reflecting its perceived level importance or effort associated with a task, and apply relevant labels to categorize and facilitate the tracking of tasks.

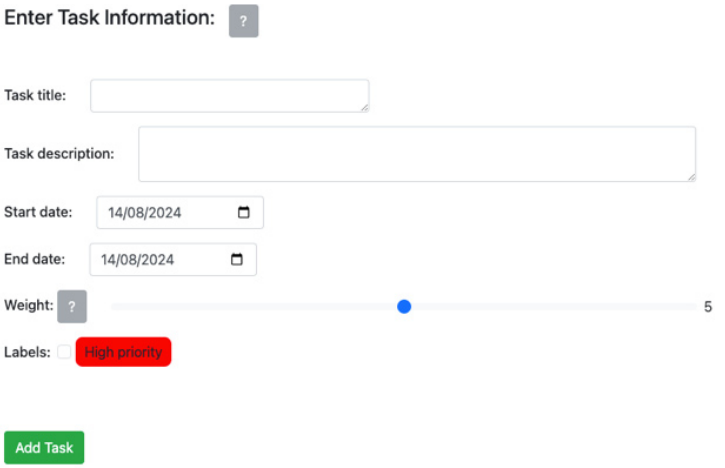

Fig. 4. Screenshot of task creation page

The task dashboard, which can be accessed through the tasks button associated with each goal, functions as a central hub for managing tasks related to goal achievement (see Fig. 5). This interface allows users to perform a range of actions including the addition of new tasks, monitoring the distribution of task statuses through percentage metrics, and executing various operations such as opening, editing, or deleting tasks. By default, tasks are categorized under the "To Do" status on a Kanban board, but users also have the option to update task statuses to "In Progress" or "Done" as their work progresses. The Tasks feature is designed to support both the forethought and performance phases of SRL. It provides users with tools to control and monitor their learning progress, thereby enhancing their ability to plan and execute tasks effectively while observing their advancement toward their goals.

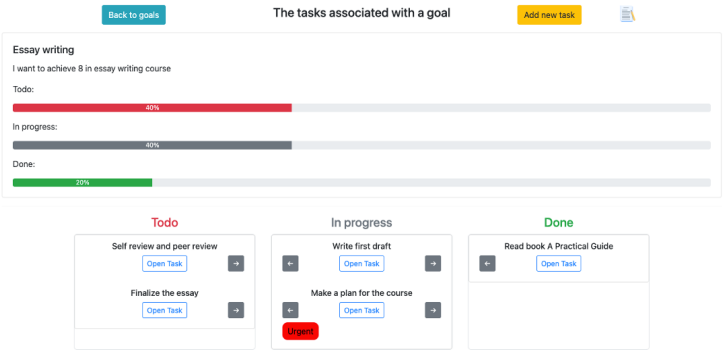

Fig. 5. Screenshot of the task dashboard

5.3.3 *Reflections*

In Zimmerman's model, self-reflection is a crucial component that significantly influences the evaluation of progress and the development of self-awareness during the pursuit of goals. The application incorporates four distinct types of reflections, each designed to align with different stages of goal achievement, ranging from the initial creation of a goal to its eventual completion. These reflections are intended to guide users in critically assessing their progress, understanding their challenges, and reinforcing their commitment to achieving their objectives.

During goal creation, users are prompted to provide initial reflections on their confidence in achieving the goal, fostering early self-awareness (see Fig. 2). As they progress, intermediate reflections are available to enable periodic evaluation of their experiences and advancement. These reflections cover various metrics, including progress assessment, emotional responses, and open-ended reflections that are guided by specific prompts (see Fig. 6).

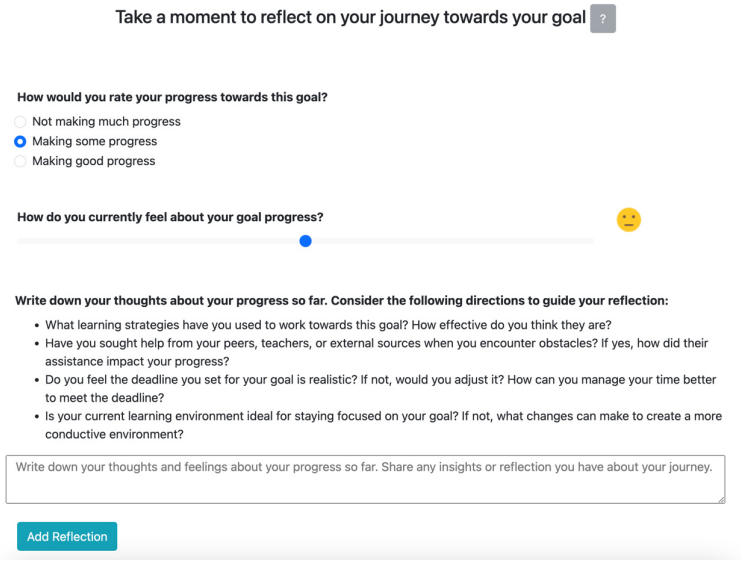

Fig. 6. Screenshot of the intermediate reflection

In addition to intermediate reflections, users are required to complete a task reflection survey each time a task is marked as 'Done.' These task reflections prompt users to critically assess the tasks they have completed and consider how these tasks contribute to overall goal attainment. The reflections include questions that evaluate the usefulness of the task, the effectiveness of the learning strategies employed, and the user's task performance, all measured on a five-point Likert scale.

Upon goal completion, users have the opportunity to engage in post-reflections, which offer a comprehensive evaluation of their entire journey. These reflections are organized into three sections: users are encouraged to rate their overall satisfaction with the goal achievement, reflect on key moments of success, and analyze any obstacles they encountered along the way.

All reflections, including initial, intermediate, task, and post-

reflections, are accessible through the reflection dashboard. This dashboard consolidates data from each type of reflection into separate tables, allowing users to track their reflections over time and gain actionable insights into their learning progress and strategies.

5.3.4 *Classes and Templates*

While users have the capability to monitor their goals and tasks on an individual basis, the application also offers the option to create and participate in classes, thereby enabling multiple students to engage in virtual classroom environments. This feature enhances collaborative learning by allowing both teachers and students to create, join, or exit classes as needed. The process of creating a class is straightforward: users provide a title and description for the class, after which they gain access to a class dashboard. This dashboard displays the current members of the class and provides a unique group code that others can use to join (see Fig. 7).

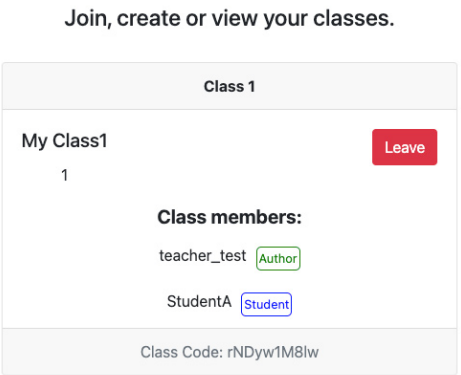

Fig. 7. Screenshot of the class

Within these enrolled classes, members have access to shared goals and templates curated by teachers. This sharing feature is particularly beneficial for guiding new learners in the practice of goal setting. In a typical middle-school classroom setting, teachers play a pivotal role in helping students establish effective goal-setting practices. To facilitate this, teachers can either predefine specific goal and task structures or intentionally leave certain elements open for students to complete themselves. These predefined structures and templates are then made available to students, who can adapt and personalize them within their portfolios. This approach not only supports individualized learning but also fosters a structured yet flexible environment where students can learn to set and achieve their own goals effectively.

5.3.5 *Additional Features*

The application includes a range of additional features designed to enhance the user experience, including a Home page, labeling capabilities, language selection options, and a point system.

The Home page (see Fig. 8) serves as a central dashboard, offering users a comprehensive overview of all their goals and tasks. This page allows users to monitor their goals based on their current status and track tasks according to specific time frames, such as tasks due today, within the next seven days, the next month, or those that have missed deadlines, regardless of their associated goals. This feature provides users with a clear and organized snapshot of their ongoing activities, facilitating better time management and prioritization.

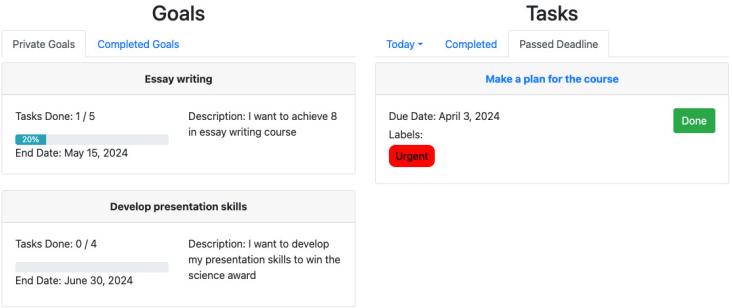

Fig. 8. Screenshot of the Home page

The application also offers a labeling feature that enables users to categorize and manage their tasks more effectively. Users can create custom labels through the settings menu, allowing them to assign specific colors and names to each label. This functionality makes it easier to organize and differentiate tasks based on personal preferences, improving task management and clarity. These labels are private and customizable, providing a tailored organizational structure that aligns with individual user needs.

To further increase the app's accessibility, it has been localized in four different languages: English, Catalan, Dutch, and Italian, and Users can easily switch between these languages using the language-switching feature, ensuring that the platform is accessible to a diverse audience. The application also supports the addition of new languages through a translation form, enabling ongoing expansion and adaptation to different linguistic needs.

Furthermore, the platform incorporates a point system designed to motivate and engage users. Users earn fixed points by default for various actions, such as creating goals and tasks. Additionally, upon successfully completing a task, users receive points that correspond to the self-assigned weight of that task. This system of point allocation introduces a gamified element to

the platform, encouraging users to consistently participate and strive toward their goals.

5.3.6 Date Export

As previously noted, the application offers a log data export option designed to assist educators and researchers in reviewing students' usage patterns and interactions within the app. This feature enables the extraction of aggregated log data, which can be requested through the Admins. The exported data includes detailed information such as the type of activity performed, timestamps, and the time spent on each activity. Additionally, it provides metrics on the total number of goals created and completed, tasks created, task movements, and reflections made. This comprehensive data set allows for in-depth analysis of user behaviour, offering valuable insights into how students engage with the app and manage their learning activities.

5.4 Progress and Future Developments

The GoaLearn app is currently in the evaluation phase, with testing underway in middle schools across three countries—Belgium, Italy, and Spain—during the 2023-2024 academic year. In this phase, 10 teachers and 150 students are participating to assess the application's effectiveness in supporting various subjects, such as foreign languages, mathematics, and art, within a classroom setting.

Development of the application continues, focusing on refining core functionalities like goal setting, progress monitoring, and self-reflection. These enhancements are being driven by the analysis of real-world usage and feedback from educational environments. We also plan to adapt the functionalities to meet the preferences of university students and conduct corresponding user studies.

The overarching goal is to comprehensively support SRL and make the application accessible to learners of all age groups. As part of this ongoing development, several new features are planned to further enrich the user experience:

– *Learning Strategies Guide*: The upcoming "Learning Center" will introduce various learning strategies to promote effective study habits. This section will offer detailed explanations and examples, helping users understand and apply these strategies. Additionally, when creating and completing tasks, users will be prompted to consider how they can implement these strategies. They will also have the opportunity to reflect on the effectiveness of their strategy use, encouraging deeper engagement with their learning process.
– *Personalized Notification System*: A notification system will be introduced to enhance progress monitoring. Users will have access to a centralized notification center where they can view, manage, and customize notifications. This includes turning notifications on or off, marking them as read, and setting preferences for the timing and type of notifications they receive. This feature is designed to improve organization and time management, allowing users to stay on top of their goals and tasks more effectively.
– *Collaborative Goal-Setting*: The app will also support collaborative goal-setting, introducing group functionalities to foster teamwork and shared accountability. Within groups, users will be able to view, create, edit, and delete group goals. Additionally, they can create group tasks under these goals and assign specific members to individual tasks. This feature is intended to promote collaboration and ensure that group members work together toward shared objectives.

In addition to expanding the application's features, we are also focused on improving the user experience (UX) by redesigning

the user interface (UI). This enhancement is essential to ensure that the application is not only functional but also intuitive, enjoyable, and easy to navigate. A well-designed UI is critical for boosting user engagement and satisfaction, making it more likely that users will interact with the app regularly and effectively.

Lastly, data security and transparency in data usage remain top priorities for ongoing refinement. Currently, the application employs encryption for passwords during user verification (login). However, as data collection becomes more integral to the app's functionality, we plan to extend encryption to all sensitive data. This measure will ensure robust protection against unauthorized access, both during data transmission and when the data is at rest. In terms of transparency, users are already informed that their data may be used for research purposes, and they have the option to delete their data directly through the application if they choose not to participate. However, this approach has a significant drawback, as it results in the loss of all progress tracking from the time they started using the app. To address this issue, we are considering the implementation of a consent option within the user settings. This feature would allow users to manage their preferences regarding data usage for research purposes. By providing this option, users can continue to track their progress while selectively opting out of having their data included in research studies, thus balancing their need for privacy with their desire to retain their learning history.

These planned enhancements aim to build upon the existing features of GoaLearn, providing users with more comprehensive and secure tools to support their learning journey. Through ongoing development and the introduction of these new functionalities, the application strives to offer a robust platform for SRL, tailored to the needs of students and educators alike.

In conclusion, this chapter introduces a goal-setting and monitoring application specifically designed to enhance students' self-regulated learning. By integrating validated theoretical models

such as Zimmerman's and prioritizing accessibility, the application holds significant potential to positively influence learning outcomes for students on a global scale. Through its thoughtful design and evidence-based approach, this tool aims to empower students in managing their educational journeys more effectively, ultimately contributing to their academic success.

Acknowledgements

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References

Baars, M., Khare, S., & Ridderstap, L. (2022). Exploring students' use of a mobile application to support their self-regulated learning processes. *Frontiers in Psychology, 13,* 585. https://doi.org/10.3389/-fpsyg.2022.793002

Bjork, R. A., Dunlosky, J., & Kornell, N. (2013). Self-regulated learning: Beliefs, techniques, and illusions. *Annual Review of Psychology, 64,* 417-444. https://doi.org/10.1146/annurev-psych-113011-143823

Breitwieser, J., Nobbe, L., Biedermann, D., & Brod, G. (2023). Boosting self-regulated learning with mobile interventions: Planning and prompting help children maintain a regular study routine. *Computers & Education, 205*, 104879. https://doi.org/10.1016/j.compedu.2023.104879

Broadbent, J., & Poon, W. L. (2015). Self-regulated learning strategies and academic achievement in online higher education learning en-

vironments: A systematic review. *The Internet and Higher Education, 27*, 1-13. https://doi.org/10.1016/j.iheduc.2015.04.007

Broadbent, J., Panadero, E., & Fuller-Tyszkiewicz, M. (2020). Effects of mobile-app learning diaries vs online training on specific self-regulated learning components. *Educational Technology Research and Development, 68*(5), 2351-2372. https://doi.org/10.1007/s11423-020-09781-6

Fournier, H., Kop, R., & Durand, G. (2014). Challenges to research in MOOCs. *Journal of Online Learning and Teaching, 10*(1), 1.

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33-40.

Tabuenca, B., Kalz, M., Drachsler, H., & Specht, M. (2015). Time will tell: The role of mobile learning analytics in self-regulated learning. *Computers & Education, 89*, 53-74. https://doi.org/-10.1016/j.compedu.2015.08.004

Van Merriënboer, J. J., Clark, R. E., and De Croock, M. B. (2002). Blueprints for complex learning: the 4C/ID-model. *Educational Technology Research and Development, 50*, 39-61. https://doi.org/10.1007/BF02504993

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology, 81*(3), 329-339. https://doi.org/10.1037/0022-0663.81.3.329

Zimmerman, B. J., & Campillo, M. (2003). Motivating self-regulated problem solvers. In J. E. Davidson & R. J. Sternberg (Eds.), *The psychology of problem solving (*pp. 233–262). Cambridge University Press.

Chapter 6.
Educational scenarios implementation, insights from teachers and students on Learning Design and Self-Regulated Learning[1]

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6.1 The SuperRED research cycles between testing and re-testing

This chapter presents and discusses the results of the implementation and testing of the educational scenarios co-designed by the teachers and the researchers involved in the SuperRED project with the aim of evaluating the effectiveness of the SuperRED approach in improving teachers' skills in Learning Design (LD) and students' abilities in Self-Regulated Learning (SRL). As widely explained in Chapter 4, the co-design and testing in SuperRED followed the methodology of Design-Based Research (DBR), a productive approach enabling theoretical advancement through the design practice and implementation in the real-world context (Design-Based Research Collective, 2003). To achieve this result, DBR entails iterative cycles of design, testing and refinement,

1 Although the study has been jointly conceived by the authors of the chapter and scientifically supervised by Maria Ranieri, Alice Roffi wrote paragraph 6.3, Gabriele Biagini paragraph 6.2 and Stefano Cuomo paragraphs 6.1, 6.2.5 and 6.4.

which in SuperRED took the shape of generating guidelines (SuperRED framework, see Chapter 2), creating and testing educational scenarios, refining and re-testing them to final identify general recommendations to improve theory and practice.

While all the phases of DBR in SuperRED are documented in Chapter 4, including the presentation of the research questions and tools adopted for the testing phases, in this chapter we report the results of the two cycles of testing that were carried out in the classrooms of the partner schools involved in the project. Specifically, the chapter is structured into three paragraphs beyond this introductory one. The paragraph 6.2 is devoted to the presentation of the results of the first cycle of testing and refinement with a focus on teachers' self-reported perceptions on the improvement of their LD skills as well as their views about the usefulness of the 4Ts game for designing collaborative learning (for more details about this tool see Chapter 3). Moreover, also findings on the extent to which the SuperRED approach influenced teachers' abilities to design and implement collaborative activities are reported together with the challenges encountered during the scenario design and implementation. This paragraph also includes the results of the refinement phase, outlining the areas for improvement that were identified during the initial implementation and the subsequent actions taken to enhance the SuperRED approach.

The paragraph 6.3 is dedicated to the results of the second cycle of testing, reporting findings about the effectiveness of the SuperRED approach in promoting students' SRL skills. This section analyses both teachers' and students' perceptions of the development of SRL abilities – forethought, performance, and self-reflection – highlighting the progress and challenges observed. It also encompasses results and reflections on the broader impact of the SuperRED approach on students' learning results and the overall effectiveness of teachers' Learning Designs (LD), including a detailed quantitative and qualitative analysis from both teachers' and students' perspectives, discussing the collaborative approach, LD approach, and SRL approach.

Finally, the paragraph 6.4 provides more general considerations of the SuperRED approach and methodology with the aim of providing transferable insights for theory and practice.

Overall, this chapter offers a comprehensive understanding into the practical application, effectiveness, and areas for improvement of the SuperRED approach in educational settings, based on the experiences and feedback from both teachers and students.

6.2 First cycle of testing: findings and refinements

6.2.1 *Context, sample and tools*

The first cycle of testing was based on the collaborative design of educational scenarios and their implementation in the partner schools involved in the project: Bernardus, ISA13, ESolc. The Belgian school is a large secondary school with about 1770 pupils (ranging between the ages of 12 and 18) and 170 staff members, while the Italian school is a comprehensive institute, including from pre-primary to secondary level of first grade, including over 1600 students and 180 teachers; finally, the Catalonian school is a small school with 340 students aged from 3 to 16 years old, comprising kindergarten, primary and secondary levels, and 40 staff members (teachers, administration).

Combining the SuperRED framework and guidelines with the use of the SRL-4T game, eight educational scenarios were created focusing on a varied range of topics and addressing students from secondary school. Table 1 below reports the number and the age of the students involved in the first cycle of testing, specifying the country and the title of the educational scenarios (for more details on the educational scenarios see Chapter 4).

	Titles of the Educational Scenarios	Samples
Belgian educational scenarios	Media Theories 101 and analyzing your own media usage	N° of students: 18 Age: 14-16
	Microsoft Excel	N° of students: 2 classes (21 and 20 students) Age: 13
	Accentwerking	N° of students: 50 Age: 15
Italian educational scenarios	Meet the scientist	N° of students: 23 Age: 11
	Knowing through the environment around us (Travelling: from Rome to the Constitution)	N° of students: 2 classes (18 and 20) students Age: 13
	Stay safe on the net	N° of students: 18 Age: 13
Catalan educational scenarios	Are all euro coins made of the same alloy?	N° of students: 30 Age: 13
	Art alive	N° of students: 22 Age: 15

Table 2: Sample of the first evaluation phase

The number of teachers who participated in the testing phase was 10, of whom 3 from Belgium, 5 from Italy and 2 from Catalonia. Teachers were 6 females, and 4 males, with a prevalent age-range between 45-54 years (7/10), 1 between 25-34 years, 1 between 35-44, and 1 lower than 25 years. As far as their educational background, 6/10 had a bachelor's degree, 3/10 a master's degree and 1/10 a PhD. They were teaching mainly in the lower secondary school level, and had an experience of more than 10 years of experience (6/10), 20 years (2/10), 2 more than 5 years, and 1 less than 5 years of experience.

The testing phase took place in the period March – May 2023, while the refinement was conducted in the Summer 2023.

Three main research questions (RQ) guided the testing with one focusing on teachers' LD skills, another one on students' SRL skills and the last one on the overall impact of the SuperRED approach on students' learning results. To address these questions, data were collected through surveys administered to both teachers and students at different stages of the implementation process. The surveys aimed to capture teachers' perceptions of their improvement in various LD phases and the effectiveness of the educational scenarios in fostering SRL skills among students (for more details about SuperRED methodology see Chapter 4). In the following paragraph, the main findings from the testing are presented according to the three research questions investigated in this first study.

6.2.2 *RQ1: Has the SuperRED approach (i.e., co-design of educational scenarios through the use of LD tools and grounding on the SuperRED framework) been effective and relevant in promoting teachers' LD skills in terms of professional development?*

To address RQ1, teachers' perceptions about LD skills and the educational scenarios implementation were collected through a survey, which was administered at the end of the testing phase. More specifically, the first part of the LD survey intended to measure whether teachers felt improved in approaching LD according to its different phases (i.e., Conceptualisation of the design idea, Planning and authoring, Implementation of the resulting design and enactment with learners) after having adopted the SuperRED approach (including, the use of the 4Ts game to implement the SuperRED guidelines). Teachers, in all countries, perceived an improvement to a similar extent in all LD dimensions, with value ranging between "A moderate amount" and "A lot" of the Likert scale (n=10, Dimension 1: M=3,4; Dimension 2: M=3,4; Dimension 3: M=3,3; see Figure 2).

Survey Question	LD Dimension 1 Conceptualisation of the design idea	LD Dimension 2 Planning and authoring	LD Dimension 3 Implementation of the resulting design and enactment with learners
Has your approach to LD improved through the use of the SuperRED methodological tools (the 4Ts game and template) in any of the following LD phases?	3,4	3,4	3,3

Figure 2: Synthesis of the answers of the first question on LD (n=10 teachers). It has been reported the mean value for each LD Dimension. The answer's options foreseen a likert 5-point scale from "Not at all" (1) to "A great deal" (5). The blue arrow indicates the position of the teachers' answers.

Focusing on the usefulness of the 4Ts game, all teachers appreciated it, since its use was engaging, motivating and suitable for the design of collaborative activities (n=10, engaging: M=4; motivating: M=4,2; useful: M=4,1; see Figure 3), with value ranging between "A lot" and "A great deal" of the Likert scale. Furthermore, teachers declared that the 4Ts game influenced their ability to design and implement collaborative activities (n=10, M=3,8), with values ranging between "A moderate amount" and "A lot".

Playing with the game was engaging	Playing with the game motivated me to adopt the 4Ts	Using the game is useful to design effective collaborative activities	Playing with the game did influence how I design and implement collaborative activities
4	4,2	4,1	3,8

Figure 3: Synthesis of the answers of the second question on LD (n=10 teachers). It has been reported the mean value for each characteristic of the 4Ts game. The answer's options foreseen a likert 5-point scale from "Not at all" (1) to "A great deal" (5). The blue arrows indicate the position of the teachers' answers

The last part of the survey focused on the implementation of the educational scenarios and allowed teachers to add comments and observations, that are briefly reported in the following. Most teachers (n=6/10) underlined that not all aspects of the designed scenario went as planned due to different reasons such as: the features of the tool adopted for the LD (D1: "*The freedom to use other tools is too limited"*), the time available (D2: "*Problems with timing and the few hours available per week (only 2)*"), the planning(D3: "*The time required for each activity was shorter or longer than expected",* D4: *"I had fewer sessions than planned and had to combine two sessions into one. There was a little break between some sessions*"), and students' dynamics (D5: "[lack of] *Collaboration between students*"). In this regard, 5/10 teachers declared that they would change some aspects of their design, paying more attention to the planning of the setting and timing (D2) and to the group formation (D5), increasing the self-regulating prompts (D6) and sharing the objectives of the activity with more clarity (D7). Four teachers encountered some difficulties in using the 4Ts game: two of them due to the lack of time to learn the game, one to the lack of sufficient guidelines for its use, and one to the insufficient digital competence. At last, additional questions were made to the four teachers struggling with the implementation of the 4Ts game, specifically asking which aspect/s of the game (i.e. technique, task, time, technology) was/were found most challenging. The majority of the teachers (3/4) identified the 'Task' dimension as the most concerning either because of inadequate digital skills or for the low familiarity with the card content.

6.2.3 *RQ2: Has the educational scenarios based on the SuperRED approach (i.e. co-design of educational scenarios through the use of LD tools and grounding on the SuperRED framework) been effective in promoting students' SRL skills, particularly referring to forethought, performance and self-reflection phases of SRL?*

To address RQ2 on the effectiveness of the SuperRED approach in promoting students' SRL skills, a post-survey was administered to the teachers after they designed and implemented the educational scenarios in their classrooms. Specifically, the survey gathered teachers' perceptions on how the educational scenario design process supported the development of SRL skills according to the phases of Forethought, Performance, and Self-Reflection. As it can be observed in Figure 4, results showed generally positive perceptions of the value of all SRL skills in the three different phases. The Performance phase received the highest rating (M=3,74), suggesting that teachers viewed it as most effectively promoted with its orientation to the execution of learning strategies and tasks. The Self-Reflection phase, which involves students evaluating their strategies and outcomes to refine future approaches, closely follows the previous one (M=3,57). Lastly, the Forethought phase received the lowest but still fairly positive rating (M=3,42), suggesting that teachers found it as having had a significant role in the design process.

In summary, the results from the post-survey indicate that teachers perceive the SuperRED approach as broadly effective for enabling the development of students' SRL skills across all phases, with the performance phase emerging as the most strongly facilitated likely because of the attention this phase received during the design process. Supplementary analyses of variation amongst teacher perceptions could elucidate specific components underlying different levels of effectiveness across the SRL skills in the three phases. However, a general conclusion can be made that the

positive ratings support the potential of the SuperRED approach to promote SRL skills.

Further evidence to answer the RQ2 on whether the SuperRED approach improved students' SRL skills, comes from the students' pre- and post-test surveys. They were conducted with students before and at the end of the educational scenario implementation. Moreover, the post-test included also student self-evaluation items on the extent to which the SuperRED approach supported the development of their SRL skills. As it emerges from Figure 5, the differences between the pre- and post-survey indicate an increase in scores for the performance (from the pre-survey=3,82 to the post-survey=4,11) and the self-reflection (from the pre-survey=3,05 to the post-survey=3,18) phases, suggesting the presence of perceived improvements over the intervention. However, the minor decline in the forethought phase (from the pre-survey=4,18 to the post-survey=4,07) was statistically non-significant ($p > 0,05$) and may reflect normal variation. In particular, students positively self-evaluated the benefits entailed by the application of the suggested learning strategies during the task performance. Qualitative insights highlighted an increase in motivation, a greater awareness about the learning strategies, and an improved capacity to reflect on the learning outcomes. However, some challenges were noted regarding the initial planning activities.

Overall, the quantitative pre- and post-survey as well as the qualitative findings point out that students perceive the SuperRED approach as beneficial for enhancing performance and SRL abilities. Although further analysis is advised to assess the optimal integration of SRL within the SuperRED approach, the preliminary results show an improved SRL, especially regarding execution and reviewing of personal learning strategies. Obviously, given its low scoring, a greater attention to the self-reflection phase must be provided to ensure improvements even in this important area of self-regulation processes.

As far as the classroom observation is concerned, it was con-

ducted by researchers only in Italy, within the implementation phase of the educational scenario "Stay safe on the net". Despite the low number of observations, it is worth mentioning the results emerged on the promotion of SRL skills and collaboration among students. As for SRL skills, teacher's actions associated to the "Forethought" dimension are reported in the notes of the observer meaning that particular attention was given to the sharing of the objectives of the activities (observer: "*Teachers explained the learning objective of the first phase and mentioned those of second phase*") or to guide the collaborative work (observer: "*The teachers define the objectives of the group work*"). However, learning objectives were not explained since the beginning of the activity, but only during its implementation (observer: "*The teachers did not clearly share the objectives before starting. Shortly after they started, they clarified some aspects*"). As for the Performance dimension, it emerged that teachers supported students in the emotional/motivational aspects, through the positive feedback to their work (observer: "*Teacher A: You were very good and We do a good job as always, Teacher B: Yes, well done*"). Some aspects were not considered during the implementation, mainly referring to the support of the student's motivation, time control and distraction avoidance. Lastly, the Self-Reflection dimension was not completely promoted, since teachers were limited to encouraging students in monitoring the achievement of learning objectives and finding a strategy to visualize the student's improvement (observer: "*The teachers ask the students to give feedback on how the group has worked so far. The teacher creates a table on the blackboard, a column with the list of groups, one with a smiling face and one with a sad face and then writes the positive and negative things that the children say*"). Qualitative notes on the collaborative processes observed in Italy are reported in the next paragraph.

6.2.4 *RQ3: If and to what extent the proposed approach (co-design of educational scenarios, including the forethought, performance and self-reflection phases of SRL, using LD tools and grounding on the SuperRED framework) produced an impact on students learning results, suggesting the effectiveness of teachers learning design?*

To examine teachers' answers related to this research question, we carried out a quantitative and qualitative analysis of data, triangulating them and focusing on the three perspectives: the collaborative approach, the LD approach, and the SRL approach, which were all promoted within the project. For this analysis, we did not limit to the impact that the educational scenarios had on the learning outcomes, but we also considered other factors such as student engagement, enjoyment, perceived difficulties, collaboration with peers, and the overall experience within the learning environment. By examining these diverse factors, we obtained a more holistic understanding of how the SuperRED approach influenced not only students' academic achievements but also their overall experience, motivation, and participation in the learning process.

6.2.4.1 Collaborative Approach

As far as teachers' perceptions are concerned, 60% emphasize a strong involvement of students in the planning and decision-making activities, which proved effective in learning. This is evident in comments such as "the involvement of students in the planning activities of the work allowed for better learning", which suggests that the SuperRED experience strengthened the students' collaborative approach.

Regarding the students' perceptions, the majority of them (60.46%) declared positive impressions about working with peers, consistently with teachers' perception on the effectiveness of the collaborative approach. However, a notable percentage of students

(19.77%) stated to be indifferent, indicating that the collaborative experience may not be uniformly perceived as positive by all. Moreover, a significant portion of students were active (49,4%) or very active (27,4%) in group activities, further supporting the success of the collaborative approach. However, a small percentage felt less active (8,3%), suggesting the need for strategies to equally engage all the students.

6.2.4.2 Self-Regulated Learning Approach

As for teachers' perceptions, positive results were reported on the SRL approach. Most teachers (80%) found an increase in student autonomy and motivation - that are key aspects of SRL - as suggested by the following comment: "*The project immediately involved them, motivating them and making them more autonomous*". However, one response highlighted some difficulties in developing deep reflections, indicating that the effect of SuperRED project on SRL might require further investigation and support of the reflections phase.

Coming to students' perceptions, they mostly enjoyed practice (31,9%), discussion (26,2%), and exploration (15,9%) activities that are strongly associated with collaborative learning and SRL. The enjoyment of discussion and exploration, indeed, suggests effective engagement in collaborative and self-directed learning. Interestingly, students found more difficult explanation (27%), practice (20,1%) and questioning (19,3%) activities. This highlights that challenges emerged for students in understanding and engaging with the LD and SRL components, resulting as areas to be improved.

Finally, a large number of students found the realization of a final product to be from moderate to high important (a moderate amount 30,4%, a lot 35,3%, a great deal 13,7%), pointing out students' engagement and investment in the learning process, which can be considered as a positive feedback for both LD and SRL approaches.

6.2.4.2 Learning Design Approach

Also considering the LD Approach, teachers' perceptions are positive, hinting teachers' improvement of their ability of designing and implementing educational activities. As observed by a teacher, "*The 4T game helped me become more aware of the design of the activity stages*". This suggests that SuperRED approach positively influenced the LD process, making it more conscious and engaging.

The students' positive perceptions of collaborative activities and SRL support can mean as a proxy of the effective implementation of LD within the project, in line with teachers' considerations.

Moving to the results of the observation grids, which was examined by the UNIFI researchers, the SuperRED approach positively influenced the collaborative dimensions, which was explored through the lens of the Community of Inquiry framework (COI) (Garrison, Anderson, & Archer, 1999): all the three dimensions (Teaching presence, Cognitive presence, and Social presence) were addressed in the activities (see Chapter 4 for more details of these dimensions).

In the Teaching Presence dimension, the category *Design & Organization* was the prevalent one and the objectives and rules for group participation were clearly communicated (observer "*Teachers: Is it clear to everyone that to make a presentation requires preparation?*"). Even the category of *Facilitation and Direct Instruction* had a good representation, pointing out a balance between the need for identifying points of agreement or disagreement and the need for offering straightforward feedback (Roffi et al., 2023).

All the subcategories relating to the Cognitive Presence dimension were represented, even if the category *Exploration and Integration* was the most reported. This implies that the activities carried out during the implementation of the educational scenario promoted the examination of diverse information sources as well

as the practical application of this knowledge to bring these sources together coherently (observer: "*Guys, you need to search for information in the various materials and not just stop at the first pages*").

The high level of representation of the Social Presence dimension underlines the socially engaging environment created during the scenario implementation, considering also the most prominent categories addressed, that is *Group Cohesion* (observer: "*Three students laugh and joke around while another student tells them not to move the images in the presentation. Student 1: "Nooo, why are you pulling it up? You can't see fish like that. Student 2 laughing: The fish! the fish curse that fish*"). Even the category *Open Communication* was a notable feature, implying that students frequently posed questions, felt at ease to express themselves, and were emotionally invested in the lesson.

Overall, the SuperRED approach seems to have positively influenced students' learning results to a considerable extent, particularly in fostering collaborative learning and self-regulation.

6.2.5 *Refinements*

According to the process for the refinement phase described in Chapter 4 and based on the results of the first cycle of testing, the initial implementation of the SuperRED approach, while successful in enhancing teachers' LD skills and promoting students' SRL abilities, proved to be improvable in five areas as described below.

- ***Challenge 1 – Time management in learning activities***. A significant issue was the mismatch between expected and actual time required for activities, as well as overall time constraints. ***Improvement Action***. The design phase must place greater attention on accurately planning the setting and timing of lear-

ning activities to better align with practical constraints. ***Framework modification***. Pay attention to the definition of the timelines: It is recommended to not under or overestimate the time needed for a specific learning activity, in order to not lose students' interest/engagement. Another key point regarding time is to plan an activity that better fits the hours availability per week for a specific discipline.

- ***Challenge 2 – Managing Student Dynamics in Collaborative Work.*** Challenges in student dynamics during collaborative activities were noted, as underlined by teachers explaining why not all the designed activities went as planned. ***Improvement Action.*** According to teachers' suggestions, more attention must be given to group formation during the implementation phase to ensure effective teamwork and interaction. ***Framework modification***. Pay attention to the context in which the intervention takes place, including the background and peculiarities of the actors involved as well as the affordances of the learning environment. The learning environment influences the learning process itself: what is available in the learning environment (F2f, Re or Bl) should never be left to chance. Spend time observing your class group and its individual members. The observation of class groups is helpful, when teachers carry out collaborative activities, helping to understand how teachers can manage and support group(s) work. Moreover, it is important to consider the nature of the relationship between learners and teacher, what should be learnt and how it should be achieved.
- ***Challenge 3 – Teacher Familiarity with 4Ts Game.*** Some teachers encountered difficulties in using the 4Ts game. In particular, the technology dimension presented significant challenges. Inadequate digital competence was a recurring issue for several teachers, underscoring a gap in digital skills that may prevent the effective use of the game. ***Improvement Action.*** To tackle these challenges, for better preparing the se-

cond testing cycle in the schools, the second LTTA incorporated specific training sessions focused on the 4Ts game. These sessions aimed at familiarizing teachers with the game's content and goals, particularly addressing areas where there was a lack of understanding and enhancing their digital competences. Continuous online support was offered by the research institutions to complement the face-to-face training, offering ongoing assistance and reinforcement of understanding. This targeted approach is intended to boost teacher competence and confidence in using the 4Ts game, ensuring its effectiveness for LD. ***Framework modification***. Use a LD tool both to reflect on teachers' way of thinking and behaving or to foster a different approach. The use of a LD tool can foster a smoother and more organic design experience for novice teachers or for teachers who usually design in a rough fashion, or to foster greater creativity in the case of teachers who tend to design in a rigid way. Teachers should take their time to understand how to use the LD tools, both following the instructions or asking colleagues in the perspective of a community of practice.

- ***Challenge 4 – Enhancing Self-Reflection in SRL.*** The self-reflection phase consistently scored the lowest among students in terms of perceived improvements. ***Improvement Action.*** To enhance this critical review process, the second cycle of testing is planned to integrate the use of a digital app designed on-purpose for the students. Within the app, metacognitive learning diaries are linked to the completion of in-class tasks and activities, to promote consistent and structured reflection on strategy effectiveness by prompting entries both during and after task performance. The app, to be used on students' devices, enables on-demand access and entry prompts to catalyse reflective behaviour as part of students' workflow. Given the generally high student adoption of digital solutions, blending it into the educational scenario design holds strong potential

to boost engagement in productive self-refining cycles. Tying students' reflections directly back into the personalized lessons has the potential to strengthen the integration between planning, performing, and reviewing personal learning approaches. The app thereby offers targeted support to the SRL process component found most challenging.

- ***Challenge* 5 – Collecting student's data.** Teachers also pointed out the students' difficulties in filling in the survey at the end of educational scenarios (in all school contexts), due to linguistic barriers in terms of understanding, also considering the range of their age (12 to 18 yo). ***Improvement Action.*** This implies a refinement of the tools for the collection of students' perceptions, entailing a simplified of the pre- and post-survey. ***Framework modification.*** Since regulation involves cyclical adaptation between three phases (forethought, performance and self-reflection), emphasize regulation as a temporally unfolding process emerging from, and continuing to shape, future beliefs, knowledge, and experiences. To examine regulation requires collecting data over time and context. Support learners to continually monitor their learning to determine its ultimate value beyond their immediate learning experience, emphasizing the self-reflection phase in their practice.

6.5 Second cycle of testing: findings and reflections

6.5.1 *Context, sample and tools*

The second cycle of testing was based on a new phase of co-design of educational scenarios informed by the findings of the first cycle of testing and refinement. As a result, seven educational scenarios were designed and tested in the three partner schools of the project. Various subject matters were dealt with, while addressing stu-

dents from secondary school. Table 2 below reports the number and the age of the students involved in the second cycle of testing, specifying the country and the title of the educational scenarios (for more details on the educational scenarios see Chapter 4).

	Scenario	Sample
Belgian scenarios	Electricity: difference between series and parallel circuits	N° of students: 22 Age: 12–13
	Formatting in word	N° of students: 21 Age: 12–13
	Interview another student	N° of students: 22 students Age: 13-14
Italian scenarios	Ilaria Alpi: an example of courage and determination	N° of students: 24 students Age: 12
	Masterchef for a day	N° of students: 22 students Age: 12
Catalan scenarios	Collaborative art approach 8th March "Where are the women?	N° of students: 12 students Age: 16-17
	Destination UK	N° of students: 28 students Age: 14-15

The number of teachers who participated in the second cycle of testing was 14, of whom 4 from Belgium, 5 from Italy and 5 from Catalonia. Teachers were 8 females, 5 males, and 1 not binary, with a prevalent age-range between 45-54 years (6/14), 4/14 between 35-44, 3/14 between 55-65 years, 1 between 25-34 years. As for their educational background, 9/14 had a bachelor's degree, 3/14 a master's degree, 1/14 a PhD and 1/14 a teaching certificate. They were teaching mainly in the secondary school level and had an experience of more than 20 years of experience (7/14), more than 10 years (5/10), more than 5 years (1/14), and 1 less than 5 years of experience.

The second cycle of the testing took place in the period April – June 2024, including the use of the SRL-app (see Chapter 5).

Even in the second cycle of testing, three research questions (RQ) were explored with a focus on teachers' LD skills, students' SRL skills and the overall impact of the SuperRED approach on students' learning results. When compared to the research questions of the first cycle of testing, they were slightly revised to better fit the needs emerged in the refinement phase. Indeed, also the questionnaire for the students was revised to improve to be better understood by the students. More details on the methodology are included in Chapter 4. Below, the main findings from the second testing are presented according to the three research questions leading this second study.

6.5.1 *Has the SuperRED approach (i.e., co-design of educational scenarios through the use of LD tools and grounding on the SuperRED framework) been effective and relevant in promoting teachers' LD skills in terms of professional development?*

Based on the data collected from the survey administered at the end of the second cycle of testing, the effectiveness and relevance of the SuperRED approach in promoting teachers' LD skills were evaluated. The survey focused on three LD phases: conceptualisation of the design idea, planning and authoring, and implementation and enactment with learners.

The teachers' perceptions of their improvement in these phases through the use of SuperRED methodological tools (the SuperRED framework and the 4Ts game) were generally positive. The average ratings for improvement in the LD phases were as follows: conceptualisation of the design idea (3.43), planning and authoring (3.57), and implementation and enactment with learners (3.29).

Additionally, the engagement and motivation provided by the 4Ts game were well-received, with scores of 4.07 and 4.27, respectively. The utility of the game in designing effective collabo-

rative activities was rated at 4.0, and its influence on how teachers design and implement collaborative activities scored 3.79. Out of the 14 respondents, 12 indicated that they would recommend the 4Ts game to their colleagues, while only 2 would not.

When it came to the classroom implementation of their designs, 8 teachers reported that not everything worked as planned, whereas 6 reported successful implementations. Some of the open-ended responses highlighted specific challenges and areas of improvement. For example, teachers from Catalonia mentioned the need for attention to diversity and inclusion, adapting designs to students' work, and requiring additional sessions to complete everything. Belgian teachers noted dependencies on various factors like students' mood and technical issues, but generally, the planned lessons went as expected. Italian teachers cited timing as a significant challenge.

Regarding potential changes to their designs, responses were evenly split with 7 teachers indicating they would make changes and 7 indicating they would not. Specific suggestions included improving sequencing and timing, adding more details, and integrating role play.

In terms of difficulties encountered during the design with the 4Ts game, 8 teachers reported no difficulties, while others mentioned a lack of sufficient guidelines, poor digital competence, and lack of time to learn the game.

When asked about specific aspects of the design with reference to the 4T game (Chapter 3):

- *Technique*: 7 teachers reported no difficulties, 4 were unfamiliar with the contents on the cards, 2 mentioned low digital competence, and 1 cited low pedagogical competence.
- *Task*: 9 teachers reported no difficulties, 3 were unfamiliar with the contents on the cards, and 2 mentioned low digital competence.
- *Time*: 10 teachers reported no difficulties, 2 mentioned low

digital competence, 1 was unfamiliar with the contents on the cards, and 1 cited low pedagogical competence.
- *Technologies*: 12 teachers reported no difficulties, 1 mentioned low digital competence, and 1 was unfamiliar with the contents on the cards.

Briefly, while the SuperRED approach has shown to be effective and relevant in enhancing teachers' LD skills, certain areas such as digital competence and familiarity with the tools' content need further attention. The feedback from teachers suggests that while the approach is beneficial, continuous support and refinement are necessary to fully realize its potential in professional development.

6.5.2 *Has the educational scenario based on the SuperRED approach (i.e. co-design of educational scenarios through the use of LD tools and grounding on the SuperRED framework, and the use of SuperRED educational app for SRL) been effective in promoting students' SRL skills, particularly referring to forethought, performance and self-reflection phases of SRL?*

To address RQ2, a post-survey was conducted to evaluate the effectiveness of the SuperRED approach in promoting students' SRL skills. The survey focused on three phases of SRL: forethought, performance, and self-reflection, gathering both teachers' and students' perceptions.

6.5.2.1 Teachers' Perception

Teachers were asked to rate the importance of various aspects of the SRL phases (Zimmerman, 1989, 2002) in the development of their educational scenarios:

- *Forethought Phase*: teachers rated the importance of this phase in their design with an average score of 3.57.
- *Performance Phase*: this phase received an average importance rating of 3.74.
- *Self-Reflection Phase*: the importance of this phase was rated 3.46 by the teachers.

The results indicate that the SuperRED approach was perceived as effective in promoting students' SRL skills. Teachers recognized the significance of each SRL phase in their design process, with the performance phase receiving the highest importance.

As for the SuperRED app, teachers generally underlined its usefulness for monitoring self-learning, due to the features for tracking progress and difficulties encountered during the process. However, there are conflicting opinions regarding the familiarity with the app and its usability. For some teachers the students easily became familiar with the app, understanding its value as an opportunity to improve their ability to self-regulate learning. For other teachers, instead, some critical aspects to be taken into consideration for future developments: in particular, it was mentioned that the app is sometimes not very intuitive (not only for children but also for teachers) and presents a language which is sometimes difficult to understand, especially for lower secondary school students. These critical issues also have some implications in terms of accessibility, therefore making the app difficult to be used by students with specific learning needs.

Finally, the collaboration between teachers and researchers was once again a great opportunity for the development of the SuperRED app, as it was possible to test it both during the training events for teachers (LTTA) and in real contexts to support teaching and therefore detect any technical bugs to be fixed (for example relating to login, enrolment of students in the activity to be monitored, and other aspects relating to the setting).

6.5.2.2 Students' Perception

Students' perceptions were collected through a survey administered both before and at the end of the implementation of the educational scenarios. The survey assessed students' agreement with statements related to each SRL phase during school learning activities.

- *Forethought Phase*:
  - Pre-implementation: the average score was 3.16.
  - Post-implementation: this score increased to 3.25, showing a positive trend ($p<0.088$).
- *Performance Phase*:
  - Pre-implementation: the average score was 2.95.
  - Post-implementation: this score rose to 3.08, indicating improvement ($p<0.088$).
- *Self-Reflection Phase*:
  - Pre-implementation: the average score was 2.29.
  - Post-implementation: this score significantly increased to 2.72, with a high level of statistical significance ($p<0.001$).

These findings suggest that even from the point of view of the students, the SuperRED approach positively influenced students' results. Their perceptions showed notable improvements in all SRL phases post-implementation, particularly in the self-reflection phase, which had the most significant increase.

6.5.3 *If and to what extent the SuperRED approach (i.e. co-design of educational scenarios through the use of LD tools and grounding on the SuperRED framework, and the use of SuperRED educational app for SRL) produced further impact on students' skills and knowledge, suggesting the effectiveness of teachers' learning design, and on teachers' competence?*

With the term impact we intend to refer to the eventual further influence that the SuperRED approach had on students' skills and knowledge, beyond the SRL skills, and on teachers' competences, beyond the LD skills. We are not referring to the implications of the approach in the long run. That said, for answering RQ3, as in the first cycle of testing, the analysis focused on three perspectives from teachers' feedback: the collaborative approach, the learning design (LD) approach, and the self-regulated learning (SRL) approach.

Teachers were asked to rate the effectiveness of the educational scenarios considering students' skills and knowledge. In terms of the collaborative approach, teachers generally found it effective, underlining that the SuperRED approach not only permitted to engage students in complex collaborative activities, but also to allow them to bring out their potential and promote collaborative skills. In fact, one teacher stated: "*I think so because it gave them a way to test themselves in a complex activity, working in a group and working on their learning*", and another noted: "*Yes. It was a difficult class in terms of peer relationships and revealed the real potential of individuals*".

Regarding the LD approach, teachers' responses were mixed. One teacher rated the approach 3 out of 5, highlighting that the approach used in SuperRED (the Framework supported by the use of the 4Ts game) for the co-design makes them more aware about the design stages, even if it requires more time to be implemented ("*Yes. The 4T game has helped me become more aware of the design of the activity stages*,"; "*I would definitely say yes, even*

if it is a path that needs time to be used more consciously and effectively").

As for the SRL approach in SuperRED, teachers generally agreed that it has a potential, but they also stated it would need further refinement. On one hand, they found that this approach to SRL has a strong pedagogical foundation and offers them new strategies to support the students' regulation of learning process and this could be a clue of its impact on teachers' competence in promoting students' SRL ("*It has been an interesting starting point because I wanted to give more strategies to the students and make them more involved in what they learn. I have also seen that they are not used to it, and it is difficult for them to set goals and follow up on their work. I think the elements are not yet in place for there to be a real change in student learning, but we are on the way*"), but on the other hand there are needs of further studies to facilitate its implementation ("*I think the project certainly has potential in terms of self-regulated learning. The practical implementation is not yet optimal, but pedagogically it has a strong foundation*"). Moreover, in line with this tendency, another teacher declared that the innovative nature of the project contributed to be more attractive for them, despite some hurdles faced, for example the lack of time to do all the activities in the right way ("*It was effective despite not having time to do everything right. The innovation that the project represents also helped make it more attractive, despite the lack of time*").

In conclusion, the analysis indicates that the SuperRED approach had a further positive impact on students' skills and teachers' LD effectiveness. Teachers noted improvements in collaborative activities, LD awareness, and SRL strategies, as well as they perceived an impact on their practice. This shift suggests that the SuperRED approach fosters student autonomy and engagement, together with an improvement in teachers' competence and awareness on these themes (LD and SRL).

6.6 Final considerations

The comparison between the first and second testing cycles of the SuperRED approach reveals a consistent pattern of improvement in both teachers' LD skills and students' SRL skills. In both cycles, teachers reported significant enhancements in their LD skills across all phases, with the second cycles showing slightly higher improvements in the planning and authoring phase (3.57 compared to 3.4 in the first phase). The 4Ts game (Ceregini et al., 2019) was consistently appreciated for its engagement, motivation, and utility. In the second cycle, teachers rated the game's engagement at 4.07 and motivation at 4.27, slightly higher than in the first phase, which were 4 and 4.2, respectively. However, challenges in implementation, such as digital competence and design adaptation, persisted across both cycles.

Teachers in both phases recognized the SuperRED approach's effectiveness in promoting SRL skills, particularly highlighting the performance phase. In the first cycle, the performance phase received a rating of 3.74, while in the second cycle, it received a similar high importance rating. Students' survey results also reflected this pattern, with notable improvements in the performance and self-reflection phases. The second cycle, in particular, showed a significant increase in the self-reflection phase, with post-implementation scores rising from 2.29 to 2.72, indicating a growing impact on students' ability to evaluate and refine their learning strategies.

Additionally, both cycles confirmed the further positive impact of the SuperRED approach on students' skills beyond SRL and teachers' LD effectiveness.

Overall, while the SuperRED approach has proven effective in enhancing LD and SRL skills, ongoing support and refinement, particularly in digital competence and implementation strategies, are necessary to fully realize its potential. The consistent positive trends across both testing cycles highlight the approach's

robustness and its capacity to adapt and improve over time, ultimately leading to better learning outcomes and more effective teaching strategies. Finally, this adaptive characteristic is a key aspect in the perspective of project transferability, as also confirmed by the stakeholders during the last LTTA in Barcelona (July, 2024), ensuring its applicability in different contexts, thanks to the tools developed and the practical examples offered by the implementation of the educational scenarios. Further feedback from stakeholders for the final revision of the framework will be provided as a follow-up in the next months and made available on the project website.

References

Design-Based Research Collective. (2003). Design-Based Research: An Emerging Paradigm for Educational Inquiry. *Educational Researcher*, 32(1), 5–8. https://doi.org/10.3102/0013189X032001005

Ceregini, A., Persico, D., Pozzi, F., & Sarti, L. (2019). The 4Ts Game to Develop Teachers' Competences for the Design of Collaborative Learning. In D. Burgos et al. (Eds.), *HELMeTO 2019*, CCIS 1091, 192-205.

Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The internet and higher education*, 2(2-3), 87-105.

Roffi, A., Biagini, G., Cuomo, S., & Ranieri, M. (2023). A learning design approach to enhance student self-regulated learning: Insights from the Erasmus plus project - SuperRED. In *ICERI2023 Proceedings* (pp. 3178-3185). doi: 10.21125/iceri.2023.0829

Zimmerman, B. J. (2002). Becoming a Self-Regulated Learner: An Overview. *Theory Into Practice*, 41(2), 64-70. DOI: 10.1207-/s15430421tip4102_2.

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of educational psychology*, 81(3), 329.

Chapter 7.
Learning Ecologies and Self-regulated learning: Comparative analysis of students across Catalonia, Italy, and Belgium

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7.1 Introduction

To conduct this chapter, a comprehensive survey was implemented to explore the diverse Learning Ecologies (LE) of students in the participating countries of the SuperRED project: Catalonia, Italy, and Belgium. The primary objective of the survey was to analyse potential variations in learning practices, extracurricular activity, resource preferences and relationships among students from three different European countries.

LE, defined as the social, cultural, and material environments that influence the learning process, exhibit great diversity on a global scale (Amali et al., 2023). This chapter explores variations in LE based on the cultural and educational contexts of the different schools analysed (Gonzalez-Sanmamed et al., 2020).

Learning extends beyond the acquisition of knowledge and skills; it develops within a complex and dynamic environment that significantly influences the process. This environment, referred to as a learning ecology, comprises social, cultural, and ma-

terial factors that interact with one another, shaping students' learning experiences (Bronfenbrenner, 1979).

Each country's education system reflects its cultural and social values, leading to different LE. For instance, some countries emphasize traditional learning and individual study, while others promote a more constructivist and collaborative approach (Giersch et al., 2021). Moreover, cultural values influence the priorities and goals of learning. In some countries, academic excellence and preparation for higher education are primary objectives, whereas others value vocational skills training or the transmission of traditional cultural values (Spector & Park, 2017).

Access to educational technologies such as computers, the internet, and digital resources varies considerably between countries and regions. These disparities can affect learning opportunities and the quality of education, as students' access to the internet and online educational resources impacts their educational experiences (Warschauer, 2019).

This chapter is meticulously structured to provide a comprehensive analysis of the wide-ranging LE among students in the SuperRED project. It begins with an introduction that clarifies the context and objectives of the study, establishing a basis for understanding the overall implications of the research. The methodology section follows, detailing the design of the survey and the processes involved in data collection. This section is crucial as it ensures the accuracy and relevance of the findings by explaining how data were systematically collected and analysed (Creswell & Creswell, 2022).

The results are then presented in a structured format, divided into sections on activities, resources, relationships, and a general overview. This structured approach allows for a more comprehensive understanding of the different elements of the students' LE. Each section provides knowledge into specific aspects of the students' LE, helping to identify patterns and differences across the participating countries.

Finally, the chapter concludes with a discussion of the results, highlighting their implications for educational practices and policies in the participating countries. This discussion integrates the findings with existing literature.

7.2 Methodology

For this study, a descriptive quantitative methodology was employed to systematically collect and analyse data on the LE of students from three schools located in Catalonia, Italy, and Belgium. This approach provides a comprehensive and detailed view of the behavioural patterns and preferences in extracurricular activities, resources, and relationships among the students examined. Descriptive quantitative research is effective in offering a broad overview of trends and correlations, allowing for the identification of patterns that may not be immediately evident through qualitative methods.

Descriptive research plays a crucial role in educational research, as it allows for the systematic observation and description of the characteristics and behaviours of a particular population without influencing or manipulating variables. This type of research is particularly valuable in educational settings, where controlling all extraneous variables is often impractical (Knupfer & McLellan, 2001). It helps in capturing the complexities of educational environments and student behaviours, thus providing valuable insights that can inform educational practices and policies (Cohen, Manion, & Morrison, 2018).

Several studies have highlighted the significance of descriptive quantitative methodologies in educational research. For instance, Creswell (2020) emphasized the importance of such methods in providing a detailed understanding of educational phenomena. Similarly, the Handbook of Quantitative Methods for Educational Research elaborates on various effective descriptive tech-

niques that enhance the depth and reliability of educational research (Teo, 2014).

The primary instrument used in this study was a survey specifically designed to collect information about the educational contexts, extracurricular activities, resources used, and relationships of students in the participating schools in the SuperRED project: Escola SOLC (Catalonia), IC Ilaria Alpi di Sarzana (Italy), and Bernardusscholen (Belgium). The survey was developed based on existing academic literature on LE, underlining the importance of understanding different contexts to improve pedagogical practices.

The survey instrument was rigorously designed by reviewing and incorporating information from the academic literature on LE, as well as from activities held during the first Learning, Teaching, and Training Activity (LTTA) of the SuperRED project in Genoa. During this LTTA, teachers from the three participating schools collaborated to identify key aspects of students' LE that should be analysed. This collaborative effort ensured that the survey would be relevant and comprehensive. The structure of the survey is to capture a global view of the students' LE by exploring multiple dimensions such as extracurricular activities, resources, and relationships. This design was intended to provide a deeper understanding of how different factors contribute to the overall learning experience. By employing a multifaceted approach based on theoretical frameworks and practical examples from the LTTA. The survey ensured that data collected would reflect the complex interactions of elements within LE, helping a more in-depth analysis of how these ecologies support student development (Barron, 2006; Siemens, 2005).

Barron (2006) describes LE as complex configurations of learning contexts, consisting of different experiences (activities and relationships) and resources. This concept highlights the multifaceted nature of learning environments, where multiple elements interact to influence educational outcomes. The survey was

founded on these principles to facilitate comprehensive data collection across the different schools.

Additionally, Bronfenbrenner's (1979) ecological systems theory provides a useful framework for analysing the interactions between different learning environments. This theory points out the significance of different environmental systems in shaping the development of children and adolescents, being from immediate settings like family and school to wide-ranging societal influences. By incorporating these theoretical perspectives, the survey was designed to capture the complexity of LE and provide useful insights for improving educational practices.

To ensure the validity and reliability of the instrument, the survey was subjected to a rigorous review and validation process by four experts in the field of educational technology and e-learning from the research group Edul@b at the Universitat Oberta de Catalunya. This thorough review process is crucial to confirm that the survey accurately measures the desired objectives and is applicable across diverse educational contexts. This process is critical in establishing both the content and conceptual validity of the survey, guaranteeing that it reliably measures what it is meant to measure and is applicable across different cultural contexts (DeVellis, 2016).

Once the survey was validated, it was translated into the native languages of each country involved in the study, with the assistance of teachers participating in the project. This step was essential to ensure that the survey questions were not only semantically correct, but also culturally relevant and easy to understand for all the students. Research highlights the importance of culturally adapting instruments to maintain their validity and reliability across different populations (Van de Vijver & Tanzer, 2004; Beaton et al., 2000).

By involving local school teachers in the translation process, the project took advantage of their experiences into the unique cultural and linguistic characteristics of their students, further furthering the survey's applicability and relevance.

The collected data were analysed using descriptive statistical techniques, including percentages and modes, to identify patterns and trends in students' responses. This descriptive analysis offers a detailed view of the similarities and differences between the LE in the three schools. Such results are useful for understanding how various educational contexts influence students' learning and development, offering opportunities for improving pedagogical practices on an international level.

Descriptive statistical techniques are widely recognized for their ability to summarize and describe the basic features of data in a study, providing simple summaries about the sample and the measures (Loeb et al., 2017). These techniques help in revealing patterns that might not be apparent through qualitative analysis alone, making them particularly valuable in educational research (Cohen, Manion, & Morrison, 2018).

The insights gained from this analysis are crucial for developing strategies that are tailored to the diverse needs of students in different educational settings. By understanding the specific characteristics of each learning ecology, teachers can configure their pedagogical approaches to better support student learning and development (Levin & Datnow, 2012).

7.3 Results and discussion

This research aims to provide a more profound understanding of students' LE and practices through a comparative analysis across the participating countries, offering a wider view of contemporary European educational contexts. By examining and comparing the learning environments, extracurricular activities, resource uses, and students' relationships in schools from different cultural and educational backgrounds, this study seeks to identify both specific and common elements that influence student learning and development.

Comparative educational research is essential for finding out how different educational infrastructures and contexts shape student experiences and outcomes (Phillips & Schweisfurth, 2014). By providing detailed data into the LE of students in Catalonia, Italy, and Belgium, this research contributes to a more comprehensive understanding of how educational practices and policies can be optimized across different educational contexts (Crossley & Watson, 2003).

Understanding these factors is crucial for developing strategies that address the specific needs of students in different European countries, promoting equity and excellence in education (OECD, 2018). The findings from this study can help teachers, policymakers, and researchers about the best practices and areas for improvement, finally improve educational performance at an international level.

Data collection was collected from students from the three schools participating in the SuperRED project. A total of 67 Catalan students, 17 Italian students, and 75 Belgian students answered the survey. Within the Catalan participants, the gender distribution was 49.3% male, 47.8% female, 1.5% non-binary, and 1.5% other. The age distribution showed that 64.2% were 14–16 years old, 16.4% were 16–18 years old, and 19.4% were 12–14 years old (Figure 1).

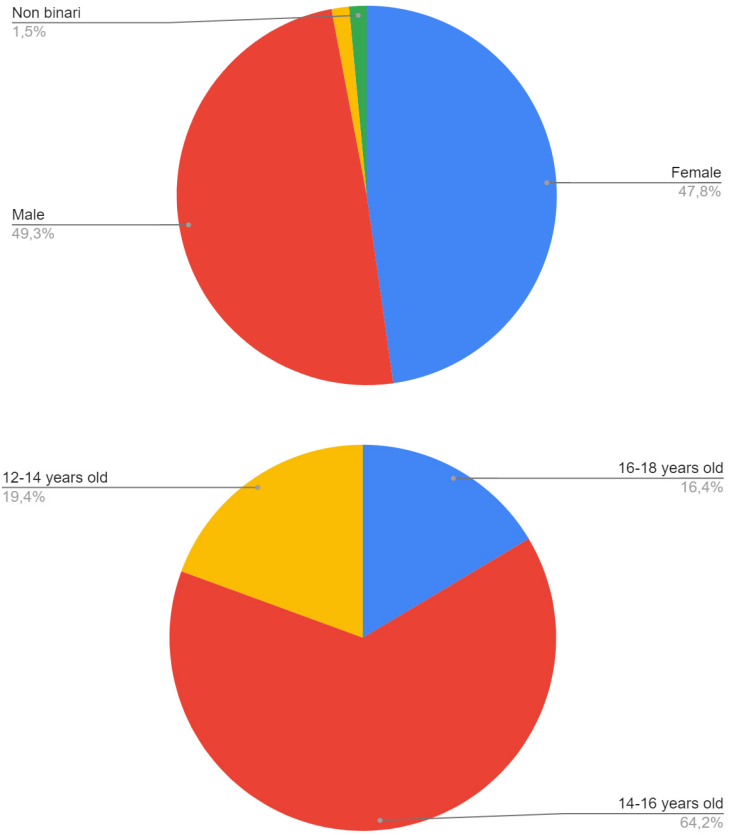

Figure 1: Distribution of the sample of Catalan students by gender and age (source: own elaboration)

For the Italian participants, 17.6% were male and 82.4% were female, with 35.3% being 10–12 years old and 64.7% being 12–14 years old (Figure 2)..

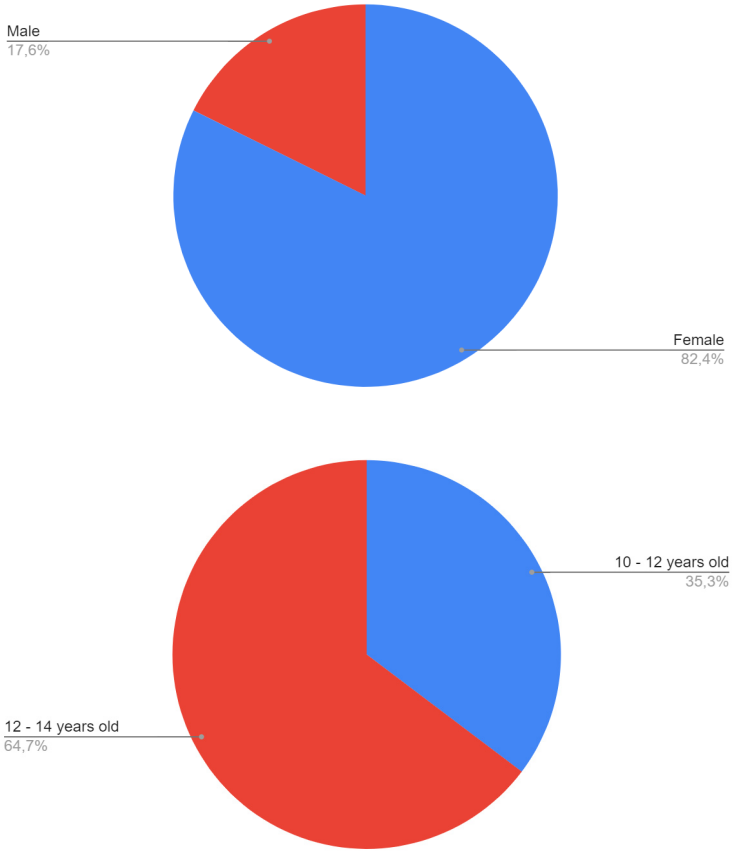

Figure 2: Distribution of the sample of Italian students by gender and age (source: own elaboration)

The Belgian participants had a gender distribution of 60% male, 38.7% female, and 1.3% non-binary. In terms of age, 88% were 12–14 years old, 6.7% were 14–16 years old, and 5.3% were 10–12 years old (Figure 3).

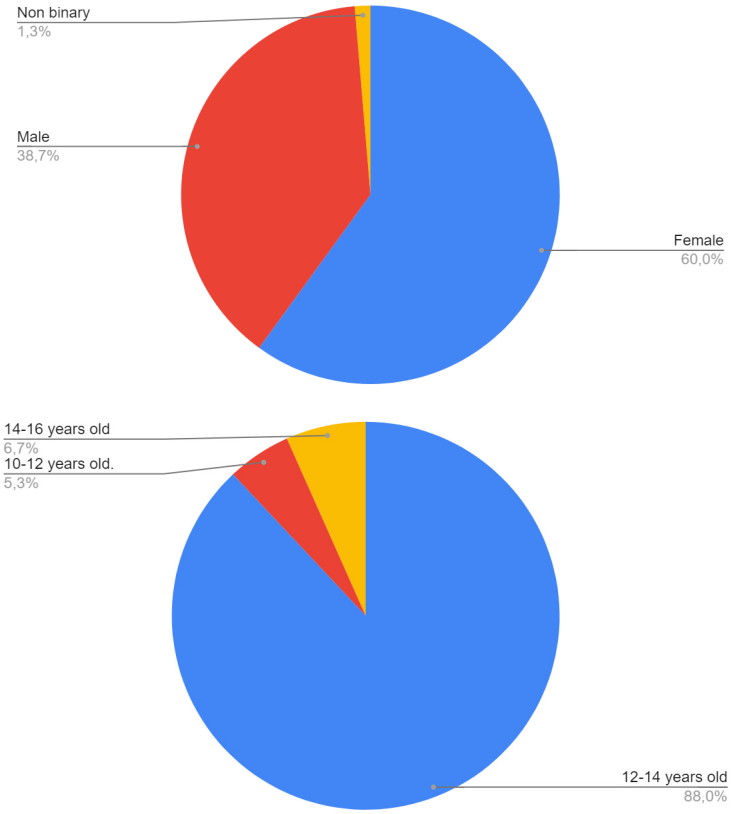

Figure 3: *Distribution of the sample of Belgian students by gender and age (source: own elaboration)*

The differences in gender and age distributions across the countries in the SuperRED project reflect the different demographic characteristics of the student samples. Catalonia's balanced gender distribution and older age range suggest a more balanced population in terms of both gender and age. In contrast, Italy's sample is mostly female and younger. Belgium's sample,

with a higher proportion of younger students and a reasonably balanced gender distribution. The differences are due to the types of schools that participated, and the groups involved in the SuperRED project could explain the reason.

7.3.1 *Activities*

The data on extracurricular activities among students from the three schools participating in the SuperRED project provides valuable perspectives into the diverse interests and engagements of these students outside the classroom.

Extracurricular activities	Catalonia	Italy	Belgium
Sports	89,55%	41,18%	73,33%
Participate in local or club sports teams	28,36%	47,06%	36,00%
Recreational activities	17,91%	11,76%	46,67%
Playing musical instruments	16,42%	29,41%	6,67%
Artistic activities	8,96%	17,65%	13,33%
Robotic and science clubs	4,48%	5,88%	0,00%
Volunteering	4,48%	0,00%	1,33%
Language clubs	25,37%	35,29%	1,33%
Scouts	23,88%	11,76%	29,33%
Games competitions	7,46%	5,88%	12,00%
Other	10,45%	5,88%	8,00%

Table 1: Preference of the extracurricular activities of students (source: own elaboration)

A significant majority of Catalan students, 89.6%, participated in sports, with 28.4% involved in sports clubs. Other popular activities included language clubs (25.4%), scouts (23.9%), recreational activities (17.9%), and playing a musical instrument (16.4%). The high participation in sports reflects the importance of physical activities in Catalonia, which aligns with studies indicating that sports play a crucial role in students' social and physical development (Bailey, 2006; Fraser-Thomas et al., 2005).

Among Italian students, 41.2% participated in sports, with a significant 47.1% involved in sports clubs. Other activities included language clubs (35.3%), playing a musical instrument (29.4%), and art activities (17.6%). The engagement in cultural and artistic activities is in line with research suggesting that such extracurricular activities contribute to students' academic and social skills (Eccles & Barber, 1999; Feldman & Matjasko, 2005).

In Belgium, 73.3% of students participated in sports, with 36% joining sports clubs. Recreational activities (46.7%) and scouts (29.3%) were also significant. The high participation in scouts and recreational activities underlines the importance of community and outdoor activities in Belgium, supporting findings that these activities promote teamwork, leadership skills, and a sense of community (Larson, 2000; Mahoney et al., 2005).

In all cases, sports are prioritized, but this is more pronounced in Catalonia and Belgium, suggesting that the schools analysed have a more developed sports culture.

Impact Extracurricular activities	Catalonia	Italy	Belgium
EA enrich my learning experience	32,84%	23,53%	4,00%
EA allow practical application of classroom knowledge	4,48%	23,53%	1,33%
EA develop communication, teamwork and leadership skills, benefiting academic skills and beyond.	38,81%	47,06%	12,00%

Balancing EA teaches me time management and discipline, improving academic organization	38,81%	35,29%	13,33%
EA keep me motivated and inspired in academics	23,88%	23,53%	4,00%
EA keep me motivated and inspired in academics	20,90%	11,76%	4,00%
EA provide stress relief, positively impacting academic focus	37,31%	29,41%	18,67%
Setting and achieving extracurricular goals teaches me how to do it academically	8,96%	5,88%	2,67%
Mentoring programs offer guidance and emotional support in the academic field	8,96%	11,76%	1,33%
Community service broadens my perspective and encourages active citizenship, complementing academic learning	14,93%	11,76%	1,33%

Table 2: Thought about the impact of the extracurricular activities in academia (source: own elaboration)

The majority of Catalan students believe that extracurricular activities significantly enhance their communication, teamwork, and leadership skills. They also recognize the value of these activities in teaching time management and discipline, as well as providing stress relief. These perceptions align with research that supports the role of extracurricular activities in developing essential life skills and emotional well-being (Eccles & Barber, 1999; Mahoney et al., 2003).

Italian students also acknowledge the development of communication, teamwork, and leadership skills through their extracurricular activities. However, they perceive a more modest impact on their academic performance. This observation is consistent with findings that while extracurricular activities are beneficial for personal and social development, their direct impact on

academic outcomes can be disparate (Feldman & Matjasko, 2005; Fredricks & Eccles, 2006).

For Belgian students, extracurricular activities are considered valuable for providing stress relief and helping with goal setting. However, they do not perceive these activities as being particularly beneficial for academic mentoring and community service. This perspective reflects research that points to the stress-relieving benefits of extracurricular activities and their role in personal development, even if their academic benefits are not always directly evident (Fredricks & Simpkins, 2012; Larson, 2000).

7.3.2 *Resources*

The data on trusted learning resources among students from the three schools in the SuperRED project reveal different preferences and levels of trust in various educational materials.

Resources	Catalonia	Italy	Belgium
Books	71,64%	76,47%	90,67%
Online articles	58,21%	82,35%	20,00%
Videos	74,63%	82,35%	33,33%
Apps	40,30%	52,94%	37,33%
Multimedia resources	37,31%	70,59%	18,67%
Class materials	76,12%	35,29%	64,00%
Expert notes	50,75%	17,65%	40,00%
Library resources	34,33%	0,00%	18,67%
Practical experience	62,69%	52,94%	16,00%
Online courses	17,91%	5,88%	41,33%
Other	14,93%	11,76%	1,33%

Table 3: Students' preferences of the resources (source: own elaboration)

The majority of Catalan students primarily trust class materials (76.1%) and videos (74.6%), followed by books (71.6%), practical experiences (62.7%), and online articles (58.2%). Online courses are the least trusted resource, with only 17.9% of students showing confidence in them. This preference for traditional and multimedia resources is supported by research suggesting that students often trust structured and teacher-endorsed materials for reliable information (Liu, 2010; Mayer, 2020).

Italian students show the highest trust in class materials (82.4%) and videos (82.4%), followed by books (76.5%), multimedia resources (70.6%), and practical experiences (52.9%). The least trusted resources are classmates' notes, with only 17.6% of students relying on them. This suggests a strong preference for professionally created and validated materials over peer-generated content, which aligns with findings that highlight the importance of perceived credibility and authority in learning resources (Metzger et al., 2010).

Belgian students trust books (90.7%) and class materials (64%) the most, with significant trust also placed in online courses (41.3%), classmates' notes (40%), interactive apps (37.3%), and videos (33.3%). Practical experiences are the least trusted resource, with only 16% of students expressing confidence in them. This distribution of trust reflects a different approach to learning, incorporating both traditional and modern resources.

The evaluation of online resources among students from the three schools in the SuperRED project reflects differing levels of scrutiny and methods for ensuring the reliability of information. Some students appear to rely more on information provided by their teachers, which they recognize as having academic rigor and integrity. Others are more open and seek additional resources in addition to the traditional ones provided by teachers. This difference may be related to differences in perceptions and abilities in searching, analysing, and selecting information in the school. Research indicates that students who rely on traditional sources,

such as those provided by teachers, often do because of the belief in the credibility and authority of these sources (Keshavarz & Esmaeili Givi, 2020). In contrast, students who explore other resources demonstrate a more general approach to information literacy, frequently engaging in cross-referencing and using different information channels, which can enhance critical thinking and evaluative skills (Hahnel et al., 2020). This difference underlines the importance of teaching comprehensive digital literacy skills to enable students to effectively navigate and understand the massive range of available information (Gerjets et al., 2011).

Evaluation of online resources	Catalonia	Italy	Belgium
Do not look	31,34%	0,00%	38,67%
Resources from trusted institution	49,25%	58,82%	29,33%
Reviews and ratings	31,34%	52,94%	34,67%
Publication date	25,37%	29,41%	24,00%
Cross-reference information	49,25%	41,18%	34,67%
Educational platforms	19,40%	0,00%	4,00%
Number and quality of citations	14,93%	5,88%	6,67%
Domain and website of the resource	31,34%	5,88%	17,33%
Consult teachers and librarians	20,90%	35,29%	9,33%
Search engines	2,99%	41,18%	21,33%
Cautious with user-generated content	28,36%	11,76%	21,33%
Other	0,00%	0,00%	4,00%

Table 4: Students'evaluation of online resources (source: own elaboration)

Among Catalan students, 49.3% prioritize reliable online resources from trusted institutions or recognized experts and engage in cross-referencing multiple sources. This approach underscores the importance of credibility and verification in their online re-

search habits. However, 31.3% of Catalan students do not prioritize source reliability, indicating a significant portion who may be vulnerable to misinformation. Research supports the importance of source verification and credibility checks in enhancing the quality and reliability of online information used by students (Metzger et al., 2010; Wineburg & McGrew, 2016).

Italian students show a higher degree of rigor in evaluating online resources, with 58.8% prioritizing sources from trusted institutions, universities, or recognized experts. Notably, all Italian students verify their sources, showing a strong commitment to ensuring the accuracy and reliability of the information they use. This rigorous verification process is in line with best practices in digital literacy, emphasizing the need for critical evaluation skills in the digital age (Julien & Barker, 2009; Leu et al., 2014).

In contrast, 38.7% of Belgian students do not verify online information, which raises concerns about their exposure to unreliable or fake news and false information. When they do verify, 34.7% rely on user reviews and ratings, and an equal percentage cross-reference multiple sources. This reliance on user-generated content for verification can be problematic, as it may not always be accurate or trustworthy. However, the practice of cross-referencing multiple sources is a positive step toward ensuring information accuracy (Walraven et al., 2009).

The Belgian approach to learning activities, which are assumed to be more participative for students, further emphasizes the importance of critical thinking and information verification skills. In Belgian schools, active learning strategies and collaborative projects are commonly used, promoting higher levels of student engagement and participation (Marsh & Klima, 2022). This participative approach encourages students to be more critical and reflective about the information they encounter, which is crucial in the digital age where misinformation is prevalent.

These findings suggest the need for specific educational strategies to enhance students' digital literacy skills, particularly

in evaluating the credibility of online resources. Teachers and policymakers must focus on teaching students critical thinking and verification techniques to navigate the complex information landscape effectively.

The use of technology among students in the SuperRED project reveals different perceptions regarding its benefits and drawbacks in educational contexts.

Technology	Catalonia	Italy	Belgium
Flexibility	77,61%	88,24%	45,33%
Self-regulated learning and setting goals	50,75%	41,18%	30,67%
Time managment	58,21%	58,82%	60,00%
Instant feedback exams	26,87%	17,65%	24,00%
Peer learning and SRL	16,42%	5,88%	1,33%
Individualized learning	46,27%	29,41%	12,00%
Gamification increase motivation	16,42%	17,65%	18,67%
Different styles of learning	43,28%	58,82%	29,33%
Continous learning following	25,37%	52,94%	20,00%
Distraction	65,67%	29,41%	50,67%

Table 5: Students' opinion about technology (source: own elaboration)

Among Catalan students, 77.6% view technology as providing learning flexibility and supporting Self-Regulated Learning (SRL). Additionally, 58.2% find digital tools beneficial for organization and task management. However, 65.7% acknowledge that technology and social networks can be distracting. These findings are also reflected in educational research, where technology is recognized for its potential to enhance learning autonomy and organization, but also for its capacity to introduce distractions (Azevedo et al., 2010; Junco & Cotten, 2012).

A substantial 88.2% of Italian students see technology as providing learning flexibility and supporting SRL, and 58.8% find digital tools beneficial. Interestingly, only 29.4% of Italian students recognize the potential distractions created by technology. This high assessment of technology's benefits aligns with studies showing that digital tools can significantly improve learning experiences by promoting engagement and self-regulation (Bandura, 2001; Zimmerman, 2008).

In Belgium, 60% of students find digital tools beneficial for organization and task management, and 45.3% see them as supporting SRL. However, 50.7% acknowledge the distracting nature of technology and social networks. This balance between being aware of the benefits and dealing with the distractions of technology is consistent with research that highlights the dual-edged nature of digital tools in educational settings (Kirschner & Karpinski, 2010; Rosen et al., 2013).

The differences in responses among students from different countries demonstrate the importance of integrating technology in a balanced way, maximizing its benefits while minimizing potential distractions. Teachers and policymakers should focus on developing digital literacy and self-regulation skills to help students deal with the challenges of technology use in learning contexts.

7.3.3 *Relationships*

The preferences for academic interactions among students in the SuperRED project reveal different approaches to seeking academic support and engagement across the three countries.

Academic interactions	Catalonia	Italy	Belgium
Tutor	47,76%	5,88%	8,00%
Study groups	26,87%	52,94%	90,67%
Peer tutoring	49,25%	5,88%	57,33%
Study skills workshops	4,48%	17,65%	2,67%
Online learning communities	10,45%	11,76%	6,67%
Summer camps	19,40%	23,53%	2,67%
Academic contests	16,42%	5,88%	4,00%
Other	7,46%	0,00%	8,00%
None	7,46%	23,53%	0,00%

Table 6: Students' academic interactions (source: own elaboration)

Catalan students show a preference for meeting with their class tutor (47.8%) and peer tutoring (49.3%). However, only a small percentage (4.5%) participate in study skills workshops. This preference for direct, personalized interactions aligns with research that supports the efficacy of one-on-one tutoring and peer-assisted learning in enhancing academic performance (Topping, 2005; VanLehn, 2011). The low participation in study skills workshops suggests a potential area for improvement in promoting these resources as important tools for academic success.

Italian students prefer study groups (52.9%) and summer programs (23.5%), with 23.5% not engaging in any academic interactions. The preference for study groups is supported by studies that show that collaborative learning environments can improve understanding and comprehension of information (Johnson et al., 2014). Summer programs are also valued for facilitating additional learning opportunities outside the regular school year. Though the high percentage of students not engaging in academic interactions suggests a need for more resources and support for participation in such activities.

Belgian students generally prefer interactions in class (90.7%) and with classmates (57.3%). This strong preference for in-class interactions shows that Belgian students highly value the structured environment and direct access to teachers and peers provided by the classroom. Research supports the importance of classroom interactions in fostering a productive learning environment and improving student motivation and learning results (Pianta et al., 2012).

The differences in most common academic interactions can be attributed to the various activities and methodologies used in classrooms across different schools and countries. These divergences reflect the unique cultural, social, and educational characteristics found in each educational system.

The support and guidance needed by students reflect their different preferences for academic and emotional support from others.

Support Family	Catalonia	Italy	Belgium
Often	38,81%	29,41%	8,00%
Sometimes	52,24%	52,94%	4,00%
Rarely	62,69%	41,18%	40,00%
Depends	56,72%	58,82%	13,33%
Emotional	17,91%	17,65%	9,33%
Expertise	22,39%	23,53%	16,00%
Support Teachers	**Catalonia**	**Italy**	**Belgium**
Often	22,39%	23,53%	1,33%
Sometimes	43,28%	23,53%	6,67%
Rarely	23,88%	29,41%	24,00%
Depends	44,78%	35,29%	2,67%
Emotional	5,97%	29,41%	2,67%
Expertise	37,31%	58,82%	13,33%

Support Friends	Catalonia	Italy	Belgium
Often	47,76%	23,53%	45,33%
Sometimes	43,28%	41,18%	64,00%
Rarely	20,90%	35,29%	38,67%
Depends	40,30%	76,47%	38,67%
Emotional	28,36%	17,65%	26,67%
Expertise	—	—	—

Table 7: Students' seek for support and guidance (source: own elaboration)

Catalan students primarily look for support and guidance from friends for both academic and emotional needs. They also rely on teachers and family members, though they express a preference for self-guided learning. This behaviour aligns with research indicating that peer support can significantly influence students' academic performance and emotional well-being (Wentzel et al., 2004; Rubin et al., 2006). The inclination towards independent learning reflects a growing practice where students utilize SRL strategies facilitated by digital tools and resources (Zimmerman, 2008).

Italian students seek academic support mainly from family members and teachers but rarely for emotional needs. This reliance on family for academic help corroborates the strong familial bonds and the cultural emphasis on family involvement in education typical in Italy (Berti et al., 2016). The lack of focus on emotional support from these sources suggests a potential gap that might be addressed through more integrated school-based support systems (Liu, 2020).

Belgian students frequently seek support from friends for academic matters, though less so for emotional needs. They also rely on teachers and family members for support. The reliance on teachers and family members also recommends the impor-

tance of a supportive network that includes both school and home environments in fostering student development (Eccles & Harold, 1993).

7.3.4 *Self-Regulated Learning*

The analysis of students' motivational beliefs and learning self-control techniques across the three schools reveals distinct patterns influenced by extracurricular activities, resources, and relationships.

Goals and planning: Activities	**Catalonia**	**Italy**	**Belgium**
Quite and a lot	47,76%	35,3%	29,33%
Goals and planning: Resources	**Catalonia**	**Italy**	**Belgium**
Quite and a lot	55,22%	35,3%	33,33%
Goals and planning: Relationships	**Catalonia**	**Italy**	**Belgium**
Quite and a lot	44,78%	41,18%	23,33%

Table 8: Students' reliability for goals and planning (source: own elaboration)

Motivational beliefs: Activities	**Catalonia**	**Italy**	**Belgium**
Quite and a lot	48,21%	41,17%	44,00%
Motivational beliefs: Resources	**Catalonia**	**Italy**	**Belgium**
Quite and a lot	38,81%	41,17%	20%
Motivational beliefs: Relationships	**Catalonia**	**Italy**	**Belgium**
Quite and a lot	47,77%	41,18%	17,34%

Table 9: Students' reliability for motivational beliefs (source: own elaboration)

Self-control: Activities	Catalonia	Italy	Belgium
Quite and a lot	56,72%	23,53%	26,66%
Self-control: Resources	**Catalonia**	**Italy**	**Belgium**
Quite and a lot	37,32%	17,64%	21,34%
Self-control: Relationships	**Catalonia**	**Italy**	**Belgium**
Quite and a lot	40,3%	35,3%	12%

Table 10: Students' reliability for auto-control (source: own elaboration)

The findings of these questions highlight the critical role that extracurricular activities, resources, and relationships play in shaping students' motivational beliefs, goal setting, planning, and self-regulation across the different schools of the project.

In Catalonia, extracurricular activities are significantly influential, affecting 47.76% of students in goal setting and planning, 48.21% in motivational beliefs, and 56.72% in self-control. This indicates that a robust extracurricular program can provide the necessary environment for students to develop essential skills for self-motivation and self-regulation (Bandura, 1997; Eccles & Barber, 1999). The strong influence of resources (55.22%) and relationships (44.78%) in goal setting and planning also underlines the importance of a healthy support system could foster academic success (Schunk, 1991).

In Italy, the influence of extracurricular activities on goal setting and planning (35.3%) and motivational beliefs (41.17%) is notable, but less pronounced than in Catalonia. Resources (35.3%) and relationships (41.18%) play a significant role in these areas, suggesting that an environment rich in resources and supportive relationships is crucial for student motivation (Fan & Williams, 2010). However, the relatively low emphasis on self-control importance points to a future area for educational im-

provement, where teachers could focus on enhancing students' self-regulation skills (Zimmerman, 2002).

Belgian students exhibit a similar pattern, with resources being crucial for goal setting and planning (33.33%) and extracurricular activities influencing motivational beliefs (44%). However, the influence of relationships on these factors is comparatively lower (23.33% for goal setting and planning, 17.34% for motivational beliefs). As in Italy, Belgian students have limited emphasis on self-control importance, what could indicate a need for integrating self-regulation strategies into educational programs to better support student development (Duckworth et al., 2014).

Overall, these findings emphasize the necessity of a multifaceted approach to education that includes strong extracurricular programs, good resources, and supportive relationships. This approach can significantly enhance students' SRL, motivation, and overall academic success.

By focusing on these elements, teachers can better support students in developing the skills and competencies required for academic and personal growth, ultimately fostering a more resilient and adaptable students, capable of success in different learning environments.

The approaches to progress monitoring and feedback among students reveal different preferences and practices across the three countries, spotlighting the importance of self-assessment, peer feedback, and teacher evaluations.

Progress monitoring and feedback	Catalonia	Italy	Belgium
Contrast with learning objectives	43,28%	52,94%	33,33%
Rubrics or similar	13,43%	23,53%	8,00%
Peer feedback	40,30%	11,76%	45,33%
Teacher feedback	29,85%	29,41%	33,33%
Tests and activities	29,85%	41,18%	40,00%
Self-reflection	32,84%	47,06%	32,00%
Control points	16,42%	17,65%	21,33%
Learning portfolios	14,93%	0,00%	10,67%
Co-evaluation or self-evalution controls	11,94%	11,76%	5,33%
Online tool to measure the progress	16,42%	23,53%	24,00%
None	1,49%	5,88%	2,67%
Other	4,48%	0,00%	0,00%

Table 11: Students' way to monitor their progress (source: own elaboration)

Catalan students frequently evaluate their progress against learning objectives, with 43.3% engaging in this practice. They also seek peer feedback (40.3%) to evaluate their understanding and improve their work. However, the use of rubrics is less common, with only 13.4% of students using them. This practice suggests that while Catalan students are proactive in seeking feedback, there may be less dependence on structured assessment tools like rubrics. The active use of peer feedback aligns with research indicating its effectiveness in enhancing learning and fostering a collaborative learning environment (Topping, 2024).

Italian students frequently evaluate their progress against objectives (52.9%) and use personal reflection (47.1%) as a key tool for self-assessment. Peer assessments and self-evaluations are less common, with only 11.8% of students participating in these

practices. The preference for personal reflection reflects the importance of self-awareness and self-regulation in the Italian educational context (Zimmerman, 2002). The lower emphasis on peer feedback and self-evaluation suggests an area for potential development in fostering collaborative and reflective practices among students.

Belgian students seek feedback from classmates (45.3%) and use quizzes and tests (40%) to assess their understanding. They also value teacher feedback (33.3%) and personal reflection (32%). This balanced approach, incorporating multiple sources of feedback, reflects a comprehensive strategy for monitoring progress. The significant use of quizzes and tests aligns with research that supports the role of formative assessments in providing immediate feedback and guiding future learning (Wiliam, 2011).

These findings underline the importance of varied feedback mechanisms in supporting student learning and progress monitoring. By understanding these preferences, teachers can change their assessment strategies to better meet the needs of their students.

The ways in which students adjust their learning strategies based on feedback suggest the importance of both external feedback and self-reflection in academic improvement.

Learning adjustments	Catalonia	Italy	Belgium
Balance feedback and self-reflection	32,84%	23,53%	30,67%
Feedback	52,24%	29,41%	70,67%
Self-reflection	46,27%	47,06%	30,67%
Other	2,99%	0,00%	0,00%
None	1,49%	0,00%	1,33%

Catalan students often adjust their learning strategies based on feedback received, with 53% making changes according to the feedback provided by teachers or peers. Additionally, 47% of these students use self-reflection as a tool for adjustment. Notably, 33.3% of students balance both feedback and self-reflection in their adjustment processes. This dual approach is in line with educational research that suggests that combining external feedback with self-assessment fosters SRL and promotes deeper understanding (Hattie & Timperley, 2007; Nicol & Macfarlane-Dick, 2006).

Italian students primarily rely on self-reflection (47.1%) to adjust their learning strategies. Feedback comments are also used by 29.4% of students. A smaller group, 23.5%, balances both feedback comments and self-reflection in their adjustments. The emphasis on self-reflection reflects the importance of metacognitive strategies in fostering SRL, where students evaluate their progress and make changes (Zimmerman, 2002). The use of feedback comments complements this process by providing external perspectives that can guide improvement (Brookhart, 2017).

Belgian students show a strong preference for adjusting based on feedback comments, with 70.6% using this method. Additionally, 30.67% use self-reflection to make adjustments, and the same percentage balances both feedback comments and self-reflection. The significant dependency on feedback comments demonstrates the value placed on external evaluation and the guidance it provides for academic improvement. Research supports this approach, indicating that constructive feedback can effectively improve student efforts and enhance learning results (Shute, 2008).

These findings demonstrate the diverse approaches to feedback adjustment among students from different cultural contexts, highlighting the importance of both external feedback and self-reflection in promoting effective learning strategies.

7.4 Conclusions

The findings of this study provide a comprehensive view of how cultural contexts shape educational practices and student experiences across the schools of three different European countries: Catalonia, Italy, and Belgium. The significant role of cultural backgrounds in influencing students' involvement with extracurricular activities, trust in learning resources, use of technology, relationships, and preferences for academic interactions demonstrates the importance of culturally based education in their learning development.

Within the framework of the students' LE, the involvement in extracurricular activities exhibits notable differences across each country. Cultural references and the different cultural development unique to each country may significantly influence the preferences for extracurricular activities among students.

The emphasis on sports and peer support indicates that Catalan culture values physical activity and social interaction. Catalonia, according to data collected by the European Commission (2018), continues to rank approximately 10% above the European average in sports participation. This cultural attitude is reflected by the high participation rates in sports among Catalan students and the importance that they place on peer relationships for both academic and emotional support. Research shows that social support and physical activity are deeply interconnected, with peer support playing a crucial role in increasing physical activity among teenagers (Chen et al., 2017). Furthermore, studies have found that exercising with others can boost performance and increase enjoyment, emphasising the importance of social bonding in physical activities (Davis et al., 2021).).

The variety in Italy's extracurricular activities reflects the multifaceted cultural influences that stem from the country's rich artistic and cultural heritage. Italian students engage in a diverse range of activities, including sports, language learning, and cul-

tural activities such as music and theatre. This wide-ranging approach mirrors Italy's historical and cultural background, where art and culture are deeply embedded in daily life and education.

Italy's emphasis on cultural education is supported by its vast cultural heritage, which includes numerous historical sites, museums, and art collections. This cultural richness fosters a broad educational environment that encourages students to explore and appreciate various forms of art and cultural activities. Italy's cultural heritage is strong, with notable examples like the ancient Roman towns and a wealth of monuments, churches, and museums that influence education and society (Sypnowich, 2021)

Furthermore, the Italian government's focus on cultural heritage education due to the nation's commitment to conserving and promoting its cultural assets. This approach aims to integrate cultural awareness into educational practices, providing students with a comprehensive educational experience that extends beyond traditional academics (Hoytt et al., 2022).

Meanwhile, in Belgium, the integration of sports, language learning, and recreational activities such as hiking reflects a community-oriented approach that promotes teamwork, leadership skills, and a strong sense of community. This diverse engagement in extracurricular activities reflects the country's emphasis on multifaceted education and community collaboration.

Belgium's educational framework supports a balanced development of students by incorporating a wide range of activities. Sports activities, in particular, are designed to foster teamwork and leadership skills. According to research, participating in team sports helps students develop social skills, emotional control, and a sense of belonging, which are crucial for their overall development (Fraser-Thomas et al., 2005).

Language learning in Belgium is another key component of its educational system, reflecting the country's multilingual environment (Gorter & Cenoz, 2017). Learning multiple languages improves cognitive abilities and fosters cultural awareness and

communication skills, essential for community building and leadership (Bialystok, 2011). This multilingual approach is supported by policies that encourage language learning from an early age, aiming to prepare students for participation in a globalized world (Council of Europe, 2020).

Recreational activities such as hiking also support the development of leadership and community skills. Engaging in outdoor activities encourages students to work together, develop problem-solving skills, and build a strong connection with their peers and their environment (Torkos & Egerau, 2020). These activities can significantly enhance students' social skills and community involvement, contributing to a well-rounded educational experience (Remmen & Iversen, 2022).

Another important component of LE is the relationships that determine the support students seek for academic and emotional issues. The results of this study show how cultural backgrounds significantly influence the support networks used by students in Catalonia, Italy, and Belgium. The social traditions of each country shape the ways in which students seek academic and emotional support, mirroring different educational and social values.

In Catalonia, the focus on peer support and independent learning reflects the region's cultural values of autonomy and community collaboration. According to the 2023 Catalonian Values Survey, benevolence emerged as the most significant value for the Catalan population, with an importance rating of 0.71 (Figure 4). This finding underscores the high priority that the Catalan people place on kindness and altruism in their social values (Centre d'estudis d'Opinió (Govern de Catalunya, 2024).

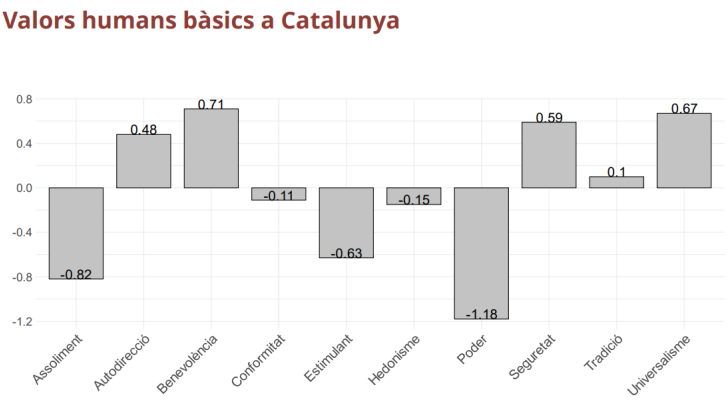

Figure 4: Ranking of basics human values for the Catalan population (source: Centre d'estudis d'Opinió (Govern de Catalunya, 2024)

The strong reliance on family for academic support in Italy underscores the deep-rooted familial bonds and the cultural importance of family in this country. Family relationships significantly influence adolescents' psychosocial outcomes and academic success (Musengamana, 2023), highlighting the crucial role of family support during their academic journey (Dmitrieva et al., 2004). In Italy, parental support is strongly linked to academic achievement, emphasizing the importance of family involvement in educational activities (Cutrona et al., 1994). So in Italy, family plays a central role in the support system for academic endeavours.

In Belgium, the support network for students, which includes friends, teachers, and family, reflects the country's community-oriented and civic engagement culture, prioritizing teamwork and collective support. According to the OECD (2020), Belgium scores 88.38 out of 100 in terms of population involvement in community activities, illustrating the high level of civic engagement (OECD, 2020) (Figure 4). This balanced support system

is emblematic of Belgium's societal values, which emphasize the importance of community cohesion and collaborative efforts. These cultural attributes are deeply ingrained in the Belgian way of life, promoting a strong sense of social responsibility and mutual support.

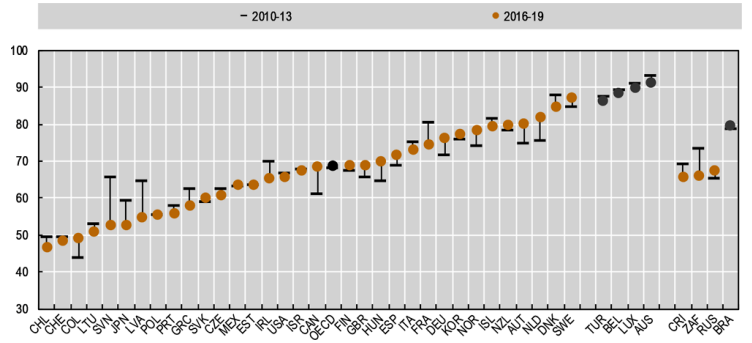

Figure 5: Belgium ranks third highest in civic engagement among countries (source: OECD, 2020).

This collective approach is indicative of Belgium's broader social culture, integrating educational practices with community engagement to foster a supportive environment for students. Belgian educational policies and community programs are designed to enhance social integration and cooperative learning, further reinforcing the importance of collective support and teamwork (Aelterman et al., 2007). The integration of these support systems is crucial for the overall well-being and academic success of students, ensuring they receive comprehensive guidance and assistance from multiple sources.

Understanding these cultural influences is crucial for developing educational strategies that are not only effective but also culturally sensitive. By tailoring educational practices to align with cultural values and preferences, educators and policymakers

can create more inclusive and supportive learning environments that cater to the diverse needs of students. This approach can promote equity and excellence in education, ensuring that all students have the opportunity to succeed regardless of their cultural background (OECD, 2018).

Overall, this study highlights the importance of comparative educational research in uncovering the complex interrelationship between cultural contexts and educational practices. The conclusions drawn from this research can inform the development of specific interventions and policies that enhance student learning and development across different cultural contexts, finally contributing to improved educational experiences at an international level.

References

Aelterman, A., Engels, N., Van Petegem, K., & Pierre Verhaeghe, J. (2007). The well being of teachers in Flanders: the importance of a supportive school culture. *Educational Studies, 33*(3), 285–297. https://doi.org/10.1080/03055690701423085

Amali, N. A. K., Ridzuan, M. U. M., Rahmat, N. H., Seng, H. Z., & Mustafa, N. C. (2023). Exploring Learning Environment Through Bronfenbrenner's Ecological Systems Theory. *International Journal of Academic Research in Progressive Education and Development, 12*(2), 124–151. http://dx.doi.org/10.6007/IJARPED/v12-i2/16-516

Azevedo, R., Johnson, A., Chauncey, A., & Burkett, C. (2010). Self-regulated learning with MetaTutor: Advancing the science of learning with MetaCognitive tools. In *New Science of Learning* (pp. 225–247). Springer New York.

Bailey, R. (2006). Physical education and sport in schools: a review of benefits and outcomes. *The Journal of School Health, 76*(8), 397–401. https://doi.org/10.1111/j.1746-1561.2006.00132.x

Bandura, A. (2001). Social cognitive theory: an agentic perspective. *Annual Review of Psychology, 52*(1), 1–26. https://doi.org/10.1146/annurev.psych.52.1.1

Bandura, Albert. (1997). *Self-efficacy: The exercise of control*. W.H. Freeman.

Barron, B. (2006). Interest and self-sustained learning as catalysts of development: A learning ecology perspective. *Human Development, 49*(4), 193–224. https://doi.org/10.1159/000094368

Beaton, D. E., Bombardier, C., Guillemin, F., & Ferraz, M. B. (2000). Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine, 25*(24), 3186–3191. https://doi.org/10.1097/-00007632-200012150-00014

Berti, C., Mameli, C., Speltini, G. & Molinari, L. (2016). Teacher justice and parent support as predictors of learning motivation and visions of a just world. *Issues in Educational Research, 26*(4), 543-560. http://www.iier.org.au/iier26/berti.pdf

Bialystok, E. (2011). Reshaping the mind: the benefits of bilingualism. *Revue Canadienne de Psychologie Experimentale [Canadian Journal of Experimental Psychology], 65*(4), 229–235. https://doi.org/-10.1037/a0025406

Brookhart, S. M. (2017). *How to give effective feedback to your students (2nd ed.)*. ASCD.

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Harvard University Press.

Centre d'estudis d'Opinió (Govern de Catalunya) (2024). Enquesta sobre valors a Catalunya 2023. Retrieved July 12, 2024, from https://upceo.ceo.gencat.cat/wsceop/9088/Dossier%20de%20premsa_1078.pdf

Chen, H., Sun, H., & Dai, J. (2017). Peer support and adolescents' physical activity: The mediating roles of self-efficacy and enjoyment. *Journal of Pediatric Psychology, 42*(5), 569–577. https://doi.org/-10.1093/jpepsy/jsw103

Cohen, L., Manion, L., & Morrison, K. (2018). *Research Methods in Education (8th ed.*). Routledge.

Council of Europe. (2020). Common European Framework of Reference for Languages: Learning, Teaching, Assessment – Companion Volume. Retrieved July 12, from Council of Europe.

Creswell, J. W., & Creswell, J. D. (2022). *Research design: Qualitative, quantitative, and mixed methods approaches (6th ed.)*. SAGE Publications.

Creswell, J. (2020). *Educational research: Planning, conducting, and eval-*

uating quantitative and qualitative research, global edition (6th ed.). Pearson Education.

Crossley, M., & Watson, K. (2003). *Comparative and International Research in Education: Globalisation, Context and Difference*. Routledge.

Cutrona, C. E., Cole, V., Colangelo, N., Assouline, S. G., & Russell, D. W. (1994). Perceived parental social support and academic achievement: an attachment theory perspective. *Journal of Personality and Social Psychology, 66*(2), 369–378. https://doi.org/-10.1037//0022-3514.66.2.369

Davis, A. J., MacCarron, P., & Cohen, E. (2021). Social reward and support effects on exercise experiences and performance: Evidence from parkrun. *PloS One, 16*(9), e0256546. https://doi.org/-10.1371/journal.pone.0256546

DeVellis, R. F. (2016). *Scale development: Theory and applications (4th ed.)*. SAGE Publications.

Dmitrieva, J., Chen, C., Greenberger, E., & Gil-Rivas, V. (2004). Family relationships and adolescent psychosocial outcomes: Converging findings from eastern and western cultures. *Journal of Research on Adolescence: The Official Journal of the Society for Research on Adolescence, 14*(4), 425–447. https://doi.org/10.1111/j.1532-7795.2004.00081.x

Duckworth, A. L., Gendler, T. S., & Gross, J. J. (2014). Self-Control in School-Age Children. *Educational Psychologist, 49*(3), 199–217. https://doi.org/10.1080/00461520.2014.926225

Eccles, J. S., & Barber, B. L. (1999). Student Council, Volunteering, Basketball, or Marching Band: What Kind of Extracurricular Involvement Matters? *Journal of Adolescent Research, 14*(1), 10-43. https://doi.org/10.1177/0743558499141003

Eccles, J. S., & Harold, R. D. (1993). Parent-School Involvement during the Early Adolescent Years. *Teachers College Record (1970), 94*(3), 568–587. https://doi.org/10.1177/016146819309400311

European Commission, Directorate-General for Education, Youth, Sport and Culture, (2017). Sport and physical activity : report, Publications Office. https://data.europa.eu/doi/10.2766/483047

European Education and Culture Executive Agency, Eurydice, (2010). *Gender differences in educational outcomes: study on the measures taken and the current situation* in Europe, Publications Office. https://data.europa.eu/doi/10.2797/3598

Fan, W., & Williams, C. M. (2010). The effects of parental involvement on students' academic self-efficacy, engagement and intrinsic motivation. *Educational Psychology, 30*(1), 53-74.

Feldman, A. F., & Matjasko, J. L. (2005). The Role of School-Based Extracurricular Activities in Adolescent Development: A Comprehensive Review and Future Directions. *Review of Educational Research, 75*(2), 159-210. https://doi.org/10.3102/00346543075002159

Fraser-Thomas, J. L., Côté, J., & Deakin, J. (2005). Youth sport programs: an avenue to foster positive youth development. *Physical Education and Sport Pedagogy, 10*(1), 19–40. https://doi.org/10.1080/1740898042000334890

Fredricks, J. A., & Simpkins, S. D. (2012). Promoting positive youth development through organized after school activities: Taking a closer look at participation of ethnic minority youth: Organized activities. *Child Development Perspectives, 6*(3), 280–287. https://doi.org/10.1111/j.1750-8606.2011.00206.x

Fredricks, J. A., & Eccles, J. S. (2006). Is extracurricular participation associated with beneficial outcomes? Concurrent and longitudinal relations. *Developmental Psychology, 42*(4), 698–713. https://doi.org/10.1037/0012-1649.42.4.698

Gerjets, P., Kammerer, Y., & Werner, B. (2011). Measuring spontaneous and instructed evaluation processes during Web search: Integrating concurrent thinking-aloud protocols and eye-tracking data. *Learning and Instruction, 21*(2), 220–231. https://doi.org/10.1016/j.learninstruc.2010.02.005

Giersch, J., Carlhed Ydhag, C. & Korhonen, V. (2021). Motivations to Become a Teacher in Finland, Sweden, and the United States. *Nordic Studies in Education, 41*(1), 62–79. https://doi.org/10.23865/nse.v41.2200

Gonzalez-Sanmamed, M., Sangrà, A., Souto-Seijo, A., & Estévez Blanco, I. (2020). Learning ecologies in the digital era: challenges for higher education. *PUBLICACIONES, 50*(1), 83–102. https://doi.org/10.30827/publicaciones.v50i1.15671

Gorter, D., Cenoz, J. (2017). Linguistic Landscape and Multilingualism. In *Language Awareness and Multilingualism. Encyclopedia of Language and Education*. Springer, Cham. https://doi.org/10.1007/978-3-319-02240-6_27

Hahnel, C., Eichmann, B., & Goldhammer, F. (2020). Evaluation of online information in university students: Development and scaling of the screening instrument EVON. Frontiers in Psychology, 11, 562128. https://doi.org/10.3389/fpsyg.2020.562128

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77*(1), 81–112. https://doi.org/10.3102/-003465430298487

Hoytt, K., Hunt, S., & Lovett, M. A. (2022). Impact of cultural responsiveness on student achievement in secondary schools. Alabama Journal of Educational Leadership, 9, 1–12. http://files.eric.-ed.gov/fulltext/EJ1362100.pdf

Johnson, D. W., Johnson, R. T., & Smith, K. A. (2014). Cooperative learning: Improving university instruction by basing practice on validated theory. *Journal on Excellence in College Teaching, 25*(3&4), 85-118.

Julien, H., & Barker, S. (2009). How high-school students find and evaluate scientific information: A basis for information literacy skills development. *Library & Information Science Research, 31*(1), 12–17. https://doi.org/10.1016/j.lisr.2008.10.008

Junco, R., & Cotten, S. R. (2012). No A 4 U: The relationship between multitasking and academic performance. *Computers & Education, 59*(2), 505–514. https://doi.org/10.1016/j.compedu.2011.12.023

Keshavarz, H., & Esmaeili Givi, M. (2020). A scale for credibility evaluation of scientific websites: findings from a cross-contextual approach. *Online Information Review, 44*(7), 1369–1386. https://doi.org/10.1108/oir-04-2020-0127

Kirschner, P. A., & Karpinski, A. C. (2010). Facebook® and academic performance. *Computers in Human Behavior, 26*(6), 1237–1245. https://doi.org/10.1016/j.chb.2010.03.024

Knupfer, N. N., & McLellan, H. (2001). Descriptive Research Methodologies. In *Association for Educational Communications and Technology*. Retrieved July 11, 2024, from AECT.

Larson, R. W. (2000). Toward a psychology of positive youth development. *American Psychologist, 55*(1), 170–183. https://doi.org/-10.1037/0003-066X.55.1.170

Leu, D. J., Forzani, E., Rhoads, C., Maykel, C., Kennedy, C., & Timbrell, N. (2015). The new literacies of online research and comprehension: Rethinking the reading achievement gap. *Reading Research Quarterly, 50*(1), 37–59. https://doi.org/10.1002/rrq.85

Levin, J. A., & Datnow, A. (2012). The principal role in data-driven decision making: using case-study data to develop multi-mediator models of educational reform. *School Effectiveness and School Improvement : An International Journal of Research, Policy and Practice, 23*(2), 179–201. https://doi.org/10.1080/09243453.2011.599394

Liu, Z. (2005) Reading behavior in the digital environment: Changes in reading behavior over the past ten years. *Journal of Documentation, 61*(6), 700-712. https://doi.org/10.1108/00220410510632040

Liu, Q., Jiang, M., Li, S., & Yang, Y. (2021). Social support, resilience, and self-esteem protect against common mental health problems in early adolescence: A nonrecursive analysis from a two-year longitudinal study. *Medicine, 100*(4), e24334. https://doi.org/10.1097-/md.0000000000024334

Loeb, S., Dynarski, S., McFarland, D., Morris, P., Reardon, S., & Reber, S. (2017). Descriptive Analysis in Education: A Guide for Researchers. *Institute of Education Sciences, U.S. Department of Education*. Retrieved July 11, from Institute of Education Sciences.

Mahoney, J. L., Larson, R. W., & Eccles, J. S. (Eds.). (2005). *Organized activities as contexts of development: Extracurricular activities, afterschool and community programs.* Lawrence Erlbaum Associates Publishers.

Mahoney, J. L., Cairns, B. D., & Farmer, T. W. (2003). Promoting interpersonal competence and educational success through extracurricular activity participation. *Journal of Educational Psychology, 95*(2), 409–418. https://doi.org/10.1037/0022-0663.95.2.409

Marsh, C., & Klima, N. (Eds.). (2022). *Engaged Learning in Belgium*. Antwerp: Maklu.

Mayer, R. E. (2020). *Multimedia learning (3rd ed.)*. Cambridge University Press.

Metzger, M. J., Flanagin, A. J., & Medders, R. B. (2010). Social and heuristic approaches to credibility evaluation online. *The Journal of Communication, 60*(3), 413–439. https://doi.org/10.1111/j.1460-2466.2010.01488.x

Musengamana, I. (2023). A systematic review of literature on parental involvement and its impact on children learning outcomes. *OAlib, 10*(10), 1–21. https://doi.org/10.4236/oalib.1110755

Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and

self regulated learning: a model and seven principles of good feedback practice. *Studies in Higher Education, 31*(2), 199–218. https://doi.org/10.1080/03075070600572090

OECD (2020), *How's Life? 2020: Measuring Well-being*, OECD Publishing, Paris, https://doi.org/10.1787/9870c393-en.

OECD. (2018). *Equity in Education: Breaking Down Barriers to Social Mobility*. OECD Publishing.

Phillips, D., & Schweisfurth, M. (2014). *Comparative and International Education: An Introduction to Theory, Method, and Practice (2nd ed.)*. Bloomsbury Academic.

Pianta, R. C., Hamre, B. K., & Allen, J. P. (2012). Teacher-student relationships and engagement: Conceptualizing, measuring, and improving the capacity of classroom interactions. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 365–386). Springer Science + Business Media. https://doi.org/10.1007/978-1-4614-2018-7_17

Remmen, K. B., & Iversen, E. (2022). A scoping review of research on school-based outdoor education in the Nordic countries. *Journal of Adventure Education & Outdoor Learning*, 1–19. https://-doi.org/10.1080/14729679.2022.2027796

Rosen, L. D., Mark Carrier, L., & Cheever, N. A. (2013). Facebook and texting made me do it: Media-induced task-switching while studying. *Computers in Human Behavior, 29*(3), 948–958. https://doi.org/10.1016/j.chb.2012.12.001

Rubin, K.H., Bukowski, W., Parker, J., & Bowker, J.C. (2008). Peer interactions, relationships, and groups. In Damon, W. & Lerner, R. (Eds), *Developmental Psychology: An Advanced Course*. New York: Wiley.

Schunk, D. H. (1991). Self-efficacy and academic motivation. *Educational Psychologist, 26*(3-4), 207-231.

Shute, V. J. (2008). Focus on formative feedback. *Review of Educational Research, 78*(1), 153–189. https://doi.org/10.3102/003465430-7313795

Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning*, 2. http://www.itdl.org/Journal/Jan_05/article01.htm

Spector, J. M., & Park, S. W. (2017). *Motivation, learning, and technology: Embodied educational motivation*. Routledge.

Sypnowich, C. (2021). Monuments and monsters: Education, cultural heritage and sites of conscience. *Journal of Philosophy of Education, 55*(3), 469–483. https://doi.org/10.1111/1467-9752.12578

Teo, T. (Ed.). (2014). Handbook of quantitative methods for educational research (2013th ed.). Sense. https://doi.org/10.1007/978-94-6209-404-8

Topping, K. J. (2024). Peer Assessment. In *Improving Thinking About Thinking in the Classroom* (pp. 138–148). Routledge.

Topping, K. J. (2005). Trends in Peer Learning. *Educational Psychology, 25*(6), 631–645. https://doi.org/10.1080/01443410500345172

Torkos, H., & Egerau, A. M. (2020). Outdoor Education and Its Influence on The Successful Involvement of Pupils in The Social Life. *Postmodern Openings, 11*(4), 127-143. https://doi.org/10.18662/po/11.4/226

VanLEHN, K. (2011). The Relative Effectiveness of Human Tutoring, Intelligent Tutoring Systems, and Other Tutoring Systems. *Educational Psychologist, 46*(4), 197–221. https://doi.org/10.1080/00461520.2011.611369

van de Vijver, F., & Tanzer, N. K. (2004). Bias and equivalence in cross-cultural assessment: an overview. *Revue Europeenne de Psychologie Appliquee, 54*(2), 119–135. https://doi.org/10.1016/j.erap.2003.12.004

Walraven, A., Brand-Gruwel, S., & Boshuizen, H. P. A. (2009). How students evaluate information and sources when searching the World Wide Web for information. *Computers & Education, 52*(1), 234–246. https://doi.org/10.1016/j.compedu.2008.08.003

Warschauer, M. (2019). *Technology and social inclusion: Rethinking the digital divide*. MIT Press. https://doi.org/10.7551/mitpress/6699.001.0001

Wentzel, K. R., Barry, C. M., & Caldwell, K. A. (2004). Friendships in middle school: Influences on motivation and school adjustment. *Journal of Educational Psychology, 96*(2), 195–203. https://doi.org/10.1037/0022-0663.96.2.195

William, D. (2011). *Embedded Formative Assessment*. Solution Tree.

Wineburg, S., & McGrew, S. (2016). Why students can't Google their way to the truth (opinion). *Education Week*. Retrieved July 11, from https://www.edweek.org/teaching-learning/opinion-why-students-cant-google-their-way-to-the-truth/2016/11

Zimmerman, B. J. (2008). Investigating Self-Regulation and Motivation: Historical Background, Methodological Developments, and Future Prospects. *American Educational Research Journal, 45*(1), 166-183. https://doi.org/10.3102/0002831207312909

Zimmerman, B. J. (2002). Becoming a Self-Regulated Learner: An Overview. *Theory Into Practice*, 41(2), 64-70.

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13-39). Academic Press.

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This book presents the results of the European project SuperRED (2022-24), an acronym which stands for Supporting Self-Regulated Learning in Digital and Remote Education. Through the collaboration between teachers and researchers, the project aimed at increasing the overall quality of the education system, while offering methodologies and tools effectively adaptable to local contexts where the knowledge is co-designed by stimulating reflective practices.
To achieve this wide objective, SuperRED firstly focused on increasing student's levels of autonomy in the management of learning processes through innovative digital tools for improving motivation and involvement, and preserving the inclusive nature of learning opportunities. In parallel, it provided an educational training for teachers on the themes of effective remote teaching/blended learning, in order to develop digital competences on learning design and to ensure high quality inclusive digital education. All the SuperRED methods and tools, taken together, should contribute to increasing the digital readiness of the learning ecosystem for managing an effective shift towards digital education, and fostering teachers' and students' resilience to tackle unplanned events.

Co-founded by
the European Union