





# Self-regulation in Foreign Language Students' Collaborative Discourse for Academic Writing: An Explorative Study on Epistemic Network Analysis

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**Abstract.** Computer-supported collaborative learning (CSCL) settings for academic writing have become a staple in foreign language classrooms in higher education. These settings allow learners to discuss their output, assist others and dialogically assess their learning progress. To successfully do so, however, learners need to be able to effectively self-regulate their learning process. The multiple contingencies of self-regulated learning (SRL) in online collaborative writing settings have hitherto received limited attention in research. Recent advances in learning analytics and quantitative ethnography, nevertheless, offer new opportunities to analyse learner discourse and reveal previously underexplored aspects of SRL. Through the use of epistemic network analysis (ENA), this study examines structural patterns in students' use of SRL strategies and meta-strategies, and models their co-occurrence. Data were collected from a Facebook group integrated into an academic writing course for first-year foreign language majors of English ( $N = 123$ ). The results illustrate how students engage in cognitive and meta-cognitive discourse, and show that other strategies and meta-strategies in the network mainly occur in isolation. The use of ENA, in addition, reveals the different contingencies in the SRL process over time. This study contributes to the fields of quantitative ethnography, learning analytics and SRL by: 1. Showing how ENA can add to our understanding of the SRL process, and 2. by discussing which self-regulatory strategies and meta-strategies are predominantly used in CSCL settings for academic writing, which ones deserve additional attention when integrating CSCL settings in this context, and what educational interventions can be designed as support.

**Keywords:** Self-regulated learning · Epistemic Network Analysis · Learning Analytics · CSCL · Academic writing · Foreign language learning

## 1 Introduction

Learners' ability to write in an academic context is an integral part of disciplinary learning, and one of the key aspects of their academic success [1]. To succeed in complex

academic writing tasks, students in higher education can benefit from the use of transferable self-regulated learning (SRL) strategies to plan, monitor and effectively govern their writing process [2]. While the awareness and command of SRL strategies have been proven to positively affect writing and learning outcomes [3], studies have shown that a majority of learners are not always capable of adequately and accurately calibrating their own learning and writing activities [4]. This lack of self-monitoring and self-assessment regarding the ways they learn, how they put their knowledge and skills to use, and how they plan their study, in turn, poses challenges for learning designers, instructors and teachers when developing relevant SRL support for academic writing.

Studying the intricate process of SRL is challenging since self-regulation is multifaceted, with many complex cognitive, affective and social dimensions that need to be accounted for [5]. While SRL has been extensively studied on a theoretical or conceptual basis, there has been “little progress in developing methods to make the primary invisible mental regulation processes [...] visible and thus measurable and ultimately interpretable” [6, p.2]. Activities and processes part of SRL continuously interact with one another, making it a dialectic course of action that lies at the very core of learning itself, and thus also at the core of learning how to write in an academic context [7]. To shed more light on this course of action, this study approaches the analysis of self-regulation as describing and illustrating the interconnectivity between different aspects of the writing process as learners plan, monitor and evaluate their learning [8].

The present study focuses on students' use of SRL strategies and meta-strategies in the setting of computer-supported collaborative writing. SRL strategies refer to students' dynamic actions or activities (e.g., reasoning or making deductions) as they engage with writing tasks, learning materials and peers to regulate multiple aspects of their learning trajectory [9]. Meta-strategies are the ways learners control or manage these processes (e.g., by paying attention, monitoring or evaluating their strategy use).

Learning analytics (LA) methods have recently made it possible to visualise the dialectic course of action described above, enabling researchers to connect trace data from online learning contexts and several learning constructs, including SRL [10]. This study builds on recent developments in the field of LA and quantitative ethnography (QE) to reveal foreign language (L2) learners' SRL process in computer-supported collaborative learning (CSCL) settings for academic writing, focusing on the interplay between and co-occurrence of SRL strategies and meta-strategies.

Previous research has shown that the application of LA methods offers valuable insights into different aspects of SRL [11]. Consequently, to understand students' use of SRL strategies and to create better support mechanisms for the development of their academic writing skills, the ways these strategies tend to be applied need to be analysed. This study aims to answer the following research questions:

1. Which self-regulated learning strategies and meta-strategies are applied by foreign language students in a computer-supported collaborative writing setting in higher education?
2. What can co-occurrence between self-regulated learning strategies and meta-strategies in a computer-supported collaborative writing setting reveal about foreign language students' self-regulated learning process for academic writing?

In applying QE methods, this paper aims to contribute to the ways co-occurrences between SRL strategies and meta-strategies in a computer-supported collaborative writing environment can be scrutinised and visualised.

## 2 Background

### 2.1 Self-regulation in Academic Writing

In academic writing tasks, learners are often expected to develop their ideas about a given topic and write a cohesive and self-sustained text. Self-regulation in writing refers to the “self-initiated thoughts, feelings and actions that writers use to attain various literary goals, including their writing skills as well as enhancing the quality of the text they create” [2, p.76]. In line with previous research [12], a recent study has shown that there is a significant positive correlation between students’ academic performance and their use of SRL tactics such as formulating learning goals, monitoring and assessing the writing process [4]. Scholars have also found that the use of SRL strategies and associated positive motivation results in decreased levels of writing anxiety [13]. Further, students’ self-efficacy beliefs about academic achievement and self-regulation of writing can be good predictors of their course grade [12].

Studies that target academic writing in L2 education found that curricula that emphasise strategy-based writing interventions result in students having higher levels of cognitive engagement, positive self-efficacy beliefs about regulating their writing process, and confidence about their written products [14].

### 2.2 Self-regulation in Online Social Networking Contexts

In CSCL research, considerable attention has been paid to the use of social networking sites to foster academic writing development in L2 learning contexts (e.g., [15, 16]). Next to providing opportunities for formal and informal learning online [17], these spaces have allowed educators and researchers to access new types of (log) data to analyse learners’ online activity as well as group dynamics. Examining SRL in these contexts is particularly interesting since “self-regulation extends beyond individualised forms of learning to include self-coordinated collective forms of learning in which personal outcomes are achieved through the actions of others” [18, p.13855].

### 2.3 LA for Self-regulated (Language) Learning

Using LA, educators and learning designers can better address language learners’ needs, predict their behaviour and assist them in creating flexible personalised learning paths [19]. One of the increasingly emerging LA areas is SRL [11]. LA for SRL consists of two interdependent parts. First, it enables us to describe students’ SRL actions and activities, based on traces and logs of the actions and activities they perform (i.e., measurement). Second, it allows us to provide recommendations (i.e., support), addressing what should be changed about the ways students engage with learning activities, about the design of the curriculum and the learning spaces, and about how these recommendations can be made applicable and sustainable [20].

## 2.4 Methods to Measure and Interpret the SRL Process

Recently, LA researchers have started to pay more attention to the ways different aspects of the SRL process interrelate and how they might develop over time [21, 22]. In addition, the field of QE has made considerable progress developing quantitative and qualitative methods to assess learning processes and human meaning-making [23]. One of the methods that has gained ground is ENA, which has been used to analyse SRL in different learning settings [24]. In recent studies, ENA has been applied in combination with LA methods such as process mining and clustering (e.g., [25]) to delve deeper into the dynamic process of SRL. In order to add to this exploration of the use of ENA, this study applies its principles to study the co-occurrence of different strategies and meta-strategies of the SRL process for academic writing, as well as to gain insights into the network of activities and processes learners apply.

## 3 Theoretical Lens: Strategic Self-regulation in Collaborative Learning Settings

Academic writing is a challenging learning activity that requires learners to be strategic, and self-regulate their learning process. The term 'strategic' is understood in relation to how self-regulated learners approach tasks by selecting strategies they believe to be best suited to the situation, and employing them adequately [26]. Oxford [9] describes the quintessential features of language learning strategies, part of, what she calls, a *Strategic Self-Regulation Model* (S2R) for language education, based on Zimmerman's [8] cyclical SRL model, as follows:

"L2 learning strategies are complex, dynamic thoughts and actions, selected and used by learners with some degree of consciousness in specific contexts in order to regulate multiple aspects of themselves (such as cognitive, emotional, and social) for the purpose of (a) accomplishing language tasks; (b) improving language performance or use; and/or (c) enhancing long-term proficiency. [...] Learners often use strategies flexibly and creatively; combine them in various ways, such as strategy clusters or strategy chains; and orchestrate them to meet learning needs" [9, p.48].

Learners can use strategies before, during and after completing a task, which Zimmerman [8] refers to as *forethought*, *performance* and *self-reflection* in his SRL model. This is a key feature since guiding learners on how to use learning strategies also requires them to make choices on timeliness, appropriateness and need [27], and thus also requires educators to let learners discover and try out strategies, explicitly or implicitly introduce new strategies to them, and provide scaffolded support along the way [28]. The S2R model covers three key constituting dimensions of self-regulated language learning: *cognitive*, *affective*, and *sociocultural-interactive*. Cognitive strategies and meta-strategies help learners to construct, transform and apply L2 knowledge. Affective strategies and meta-strategies help them create positive emotions and attitudes and stay motivated. Sociocultural-interactive strategies and meta-strategies aid the learner with communication, navigating sociocultural context, and identity. This study uses the SR2 model as a theoretical lens to examine the phases of the SRL process (*forethought*, *performance* and *self-reflection* [8]) and the SRL strategies and meta-strategies employed by students in a CSCL academic writing context.

## 4 Methods

### 4.1 Context and Data Collection

This study examines the use of SRL strategies and meta-strategies by first-year L2 majors of English ( $N = 123$ ) at a Belgian University who used Facebook as a collaborative space for peer review in an academic writing course. Students used the online space to share their course tasks, discuss and assess their progress, share experiences and review each other's work. The course consisted of 12 face-to-face contact hours, blended with an online self-access module on academic literacy, and a peer review space on Facebook. There were no tutors present in the Facebook group. Students had to hand in three 300-word essays over the course of three months. After an initial brainstorm in class, they finished their essays at home, and were reminded that they could consult with their peers on Facebook at any given time. The tutor was available in class or via email. Tutors provided feedback on the first version of the essay, after which students could hand in a final version two weeks later.

Students generated 2,550 posts and comments on the online group. Log data, including posts, comments, time stamps and participant IDs were collected using an application programming interface available to Facebook developers. In data processing, it was recorded who talked to whom, and when they did so. Informed consent was obtained from all participants and all data were anonymised.

### 4.2 Data Annotation

In the deductive coding process, the S2R Model for language learning [9] was adopted to annotate students' posts and comments. A team of two coders annotated the corpus in three phases, including iterations of thematic coding, descriptive coding, and refining codes and descriptors [29]. The content of posts and comments was scanned for examples of 'strategies and meta-strategies in context' such as 'planning', 'reasoning' or 'paying attention', part of an extensive list by [9]. All strategies and meta-strategies then received descriptors, based on how they were applied by students. Posts and comments could receive multiple labels as students could address or apply different strategies or meta-strategies in one single post or comment. Posts such as 'Can someone please explain me the difference in use between 'fault' and 'failure'?' was labelled 'Discussing how to approach academic writing tasks, including textual features and structure' or 'activating knowledge' for short. After having annotated the entire data set, a team of four coders independently coded 20% of the transcripts for comparison. The team discussed disputed or ambiguous codes until a consensus was reached. In the end, this social moderation method [30] ensured full inter-rater agreement and accurate descriptions of the different 'strategies and meta-strategies in context'. The list of SRL strategies and meta-strategies was finalised, and final coding approved by all members of the coding team. Table 1 presents the codes of the S2R model, as well as descriptions of how they were annotated in this study.

**Table 1.** Overview of SRL strategies and meta-strategies [9], keywords and descriptors, as coded in the data set.

SRL Dimension	Strategies & meta-strategies	Descriptors	Key words
Cognitive	Planning	Discussing and implementing learning or writing plans	Planning
	Activating knowledge	Discussing how to approach academic writing tasks, including textual features and structure	Activating knowledge
	Reasoning	Discussing topics and argumentation for academic writing tasks	Reasoning
	Orchestrating strategy use	Discussing goals, objectives and requirements of tasks; discussing practical challenges and strategies to overcome them	Orchestrating strategies
	Obtaining and using resources	Sharing, discussing and evaluating resources and user-generated content	Using resources
	Paying attention	Discussing the purpose of the course and course organisation	Paying attention
	Evaluating	Discussing and applying feedback from peers and tutors about academic performance and collaboration	Evaluating
Affective	Activating supportive emotions, beliefs and attitudes	Talking about hobbies, spare time and leisure; sharing likes and dislikes about shared content	Socialising
	Generating and maintaining motivation	Expressing positive reinforcement and gratitude; strengthening social ties	Motivation
Sociocultural- interactive	Dealing with sociocultural interactive contexts and identities	Sharing and discussing personal stories, expectations and experiences about academic trajectory	Constructing identity

*(continued)*

**Table 1.** (continued)

SRL Dimension	Strategies & meta-strategies	Descriptors	Key words
	Monitoring	Signalling understanding; interacting to learn and communicate	Monitoring

### 4.3 Data Analysis

First, descriptive statistics were used to examine which SRL strategies and meta-strategies were most frequently applied by students. Later, we applied ENA [23, 31] to our data using the ENA Web Tool (version 1.7.0) [32] to investigate co-occurrence and linkage. To generate the adjacency matrix for the model, we constructed a Python script to transpose the textual codes to binary codes needed for ENA.

We defined the units of analysis as all lines of data associated with a single value of Type (different strategies and meta-strategies) subset by the three assignments they link to (Assignment\_level) and the student’s unique ID (SourceD). For example, one unit consists of all the lines associated with Assignment 1 and student 87.

The ENA algorithm uses a moving window to construct a network model for each line in the data, showing how codes in the current line are connected to codes that occur within the recent temporal context [33], defined as 4 lines (each line plus the 3 previous lines) within a given conversation. The resulting networks are aggregated for all lines for each unit of analysis in the model. In this model, we aggregated networks using a binary summation in which the networks for a given line reflect the presence or absence of the co-occurrence of each pair of codes.

The ENA model normalised the networks for all units of analysis before they were subjected to a dimensional reduction, which accounts for the fact that different units of analysis may have different amounts of coded lines in the data. For the dimensional reduction, we used a singular value decomposition, which produces orthogonal dimensions that maximise the variance explained by each dimension.

## 5 Results

### 5.1 SRL Strategies in the CSCL Context of Academic Writing

The results show that the cognitive strategies *activating knowledge* ( $N = 520$ ) and *reasoning* ( $N = 505$ ) were the most frequently used strategies followed by the sociocultural-interactive strategy of *constructing identity* ( $N = 308$ ) (Table 2). Cognitive meta-strategies such as *orchestrating strategies*, and affective strategies such as *motivation* also appear in the top five. These numbers stress the dominance of cognitive, task-oriented strategies in the CSCL setting for academic writing. That is, L2 learners seem to put considerable emphasis on negotiating content, in addition to negotiating their roles in the CSCL environment.

**Table 2.** The frequency of strategies and meta-strategies, where one status update or comment can receive more than one label.

Strategies and meta-strategies	Frequency	Ratio
Activating knowledge	520	0.20
Reasoning	505	0.20
Constructing identity	308	0.12
Orchestrating strategies	292	0.11
Motivation	273	0.11
Monitoring	255	0.10
Evaluation	170	0.07
Socialising	104	0.04
Paying attention	75	0.03
Planning	55	0.02
Using resources	12	0.00
<b>Total</b>	<b>2569</b>	<b>1.00</b>

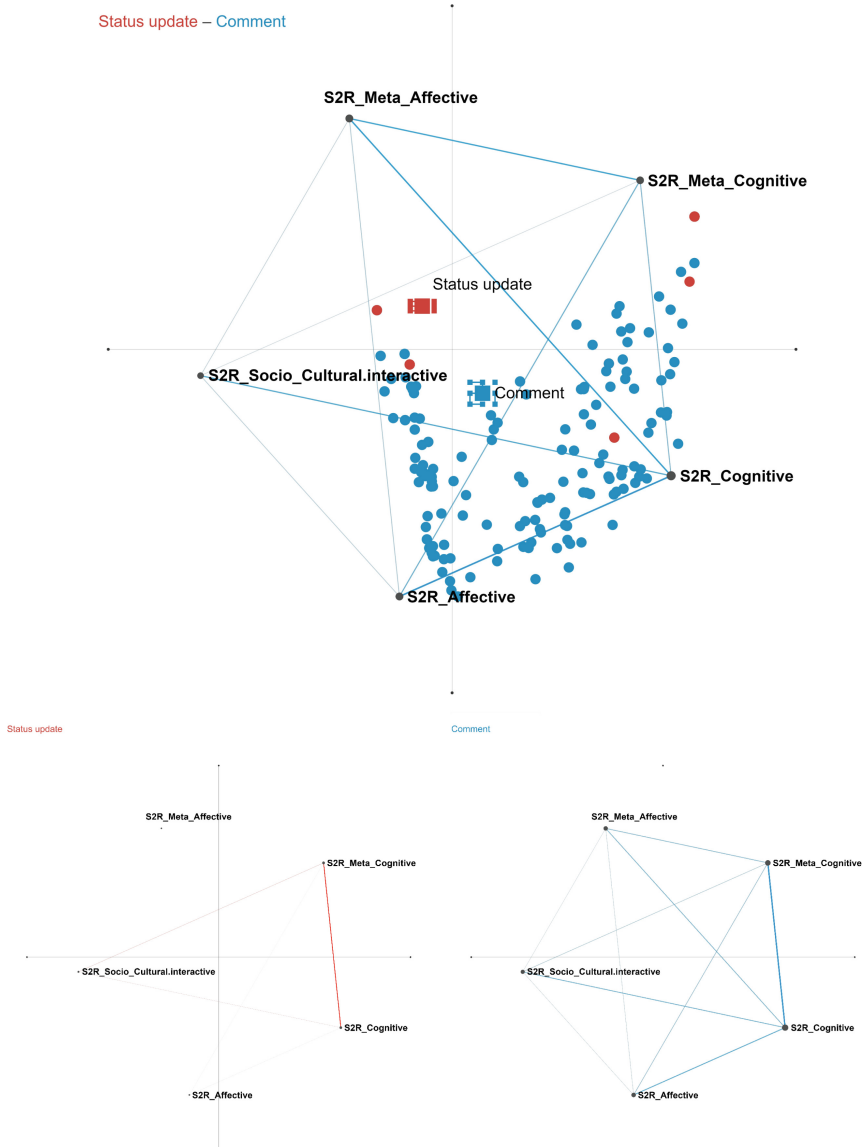
## 5.2 ENA Perspective

We generated ENA networks for the different types of strategies and meta-strategies applied by students throughout the entire period of the course (Fig. 1), where we, in addition, made separate networks for status updates and comments.

To analyse our data, we made distinctions between 'Status updates' and 'Comments', the time they were performed (i.e., during one of the three assignments), and the anonymised student IDs. We used the moving stanza window with a size of 6 to account for connected actions between the discussions. To help balance the visualisation, we used unit circle equally spaced nodes. Along the X axis (SVD1), a Mann-Whitney test showed that 'Status update' ( $M = -0.39$ ,  $N = 307$ ) was statistically significantly different at the  $\alpha = 0.05$  level from 'Comment' ( $M = -0.09$ ,  $N = 302$   $U = 68516.00$ ,  $p = 0.00$ ,  $r = -0.48$ ). Additionally, along the Y axis (SVD2), a Mann-Whitney test showed that 'Status update' ( $M = 0.18$ ,  $N = 307$ ) was statistically significantly different at the  $\alpha = 0.05$  level from 'Comment' ( $M = -0.19$ ,  $N = 302$   $U = 71538.00$ ,  $p = 0.00$ ,  $r = -0.54$ ).

For 'Status update', it can be observed that meta-cognitive and cognitive strategies tend to co-occur more frequently than any other strategies or meta-strategies in the data set. Weak connections can be observed between both cognitive strategies/meta-strategies and sociocultural-interactive strategies. No other notable connections can be observed in this section, indicating the low level of strategy/meta-strategy co-occurrence in 'Status updates' in the data set. For the 'Comment' section, the network shows more variation and, therefore, more co-occurrences of interrelated strategies and meta-strategies. The link between cognitive strategies and meta-strategies remains strong. Cognitive strategies tend to co-occur with affective strategies and meta-strategies, as well as with



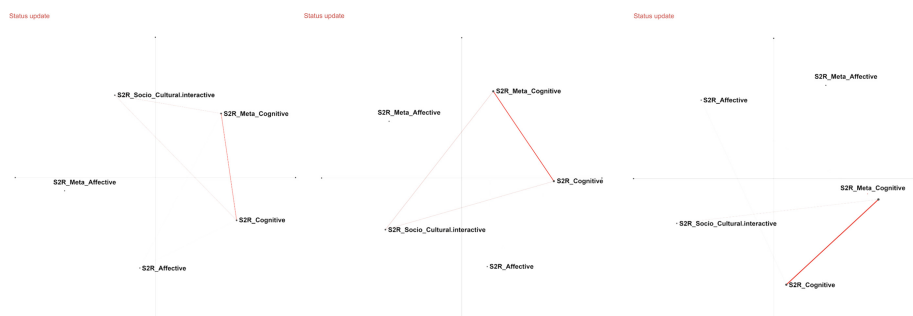


**Fig. 1.** Types of strategies and meta-strategies applied during the course, equally distributed for ‘Status updates’ and ‘Comments’ (top), for ‘Status updates’ (bottom left) and for ‘Comments’ (bottom right).

sociocultural-interactive strategies. All observed strategies and meta-strategies co-occur to some degree in the ‘Comment’ section.

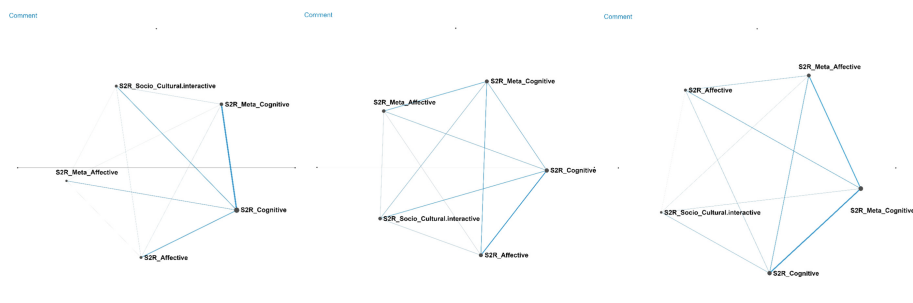
Adding intervals, taking into account that students worked on three different writing assignments over the course of three months, we can examine the evolution of strategy/meta-strategy use in status updates over time (Fig. 2). Here, we could observe

that the co-occurrence between cognitive strategies and meta-strategies became more pronounced over time, indicating that they appeared more frequently together in status updates as time went by. Other connections remained weak.



**Fig. 2.** Types of strategies and meta-strategies applied during the first, second and third assignment in status updates, equally spaced.

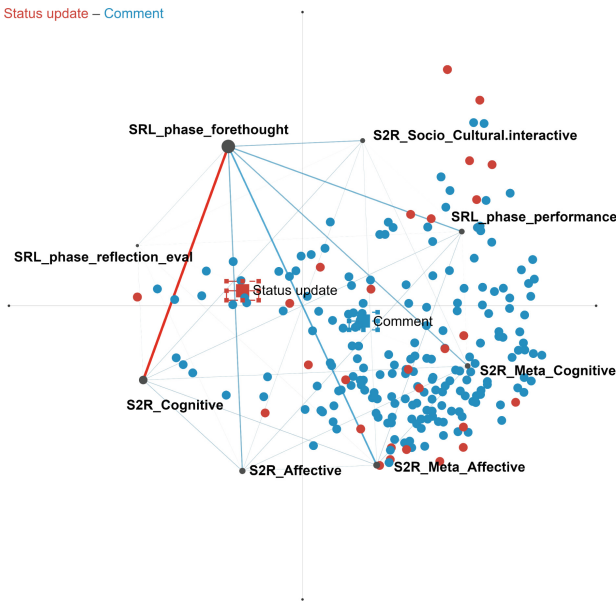
Adding intervals to the networks on the ‘Comment’ section, the evolution of strategy/meta-strategy use can also be examined (Fig. 3). Here, we can observe that cognitive strategies and meta-strategies were used very frequently together, and that their co-occurrence slightly faded over time. This observation contrasts the observations made in Fig. 2, where the link between cognition strategies and meta-strategies only grew over time. Noteworthy increases in co-occurrence can be observed in cognitive and affective meta-strategies, where, over time, the link between both grew. Noteworthy decreases occurred between cognitive strategies and sociocultural-interactive ones, indicating they tended to co-occur less and less in the data set as time went by.



**Fig. 3.** Types of strategies and meta-strategies applied during the first, second and third assignment in the comment section, equally spaced.

In order to investigate the co-occurrence between SRL strategies and meta-strategies, we visualised both the ‘Codes’ from the S2R framework with the SRL phases (*forethought, performance, self-reflection*) to gain insights into their relationship (Fig. 4). The ENA graph highlights the centrality of *forethought* and the connection to the cognitive SRL dimension, especially in the ‘Status updates’. Comments show a broader

connection to the different dimensions with medium and weak ties to cognitive and affective meta-strategies.



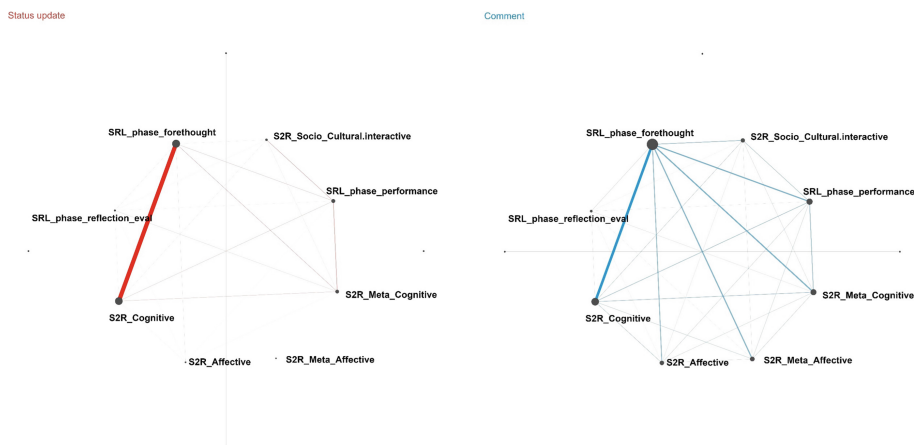
**Fig. 4.** Types of strategies and meta-strategies applied, connected to the different SRL phases, equally distributed.

When we examine strategies and meta-strategies in connection to the SRL phases, on the X axis (SVD1), the results of a Mann-Whitney test show that ‘Status update’ ( $M = 1.02, N = 307$ ) was statistically significantly different at the  $\alpha = 0.05$  level from ‘Comment’ ( $M = -0.64, N = 302, U = 25118.50, p = 0.00, r = 0.46$ ). Along the Y axis (SVD2), a Mann-Whitney test showed that ‘Status update’ ( $M = -0.05, N = 307$ ) was statistically significantly different at the  $\alpha = 0.05$  level from ‘Comment’ ( $M = 0.11, N = 302, U = 57909.50, p = 0.00, r = -0.25$ ).

As shown in Fig. 4 for ‘Status update’, the overall connection between all three phases (i.e., *forethought*, *performance* and *self-reflection*) of the SRL process that ground the S2R model [9] is somewhat weak. Regarding the use of strategies and meta-strategies, the plot shows that the L2 learners’ use of cognitive strategies is well-connected to the first phase, i.e., *forethought*, and the use of cognitive meta-strategies has been, to some extent, enabled during the *performance* phase. During the *self-reflection* phase, learners seem to use some cognitive strategies. Other types of meta-strategies and strategies are also employed, but are not closely connected to the SRL phases.

For the ‘Comment’ section, the link between the *forethought* and the *performance* phase is more pronounced, compared to ‘Status update’, and there is a weak connection between the *forethought* and the *self-reflection* phase (Fig. 5). Overall, we can see clearer links between these phases. Also, students used a variety of strategies and meta-strategies. These are better connected when compared to the status updates. In particular, they

used cognitive strategies during all the phases, as well as cognitive and affective meta-strategies to regulate their writing process during the *forethought* phase when providing comments. Reflection and evaluation, in both cases, seems to lag behind and remained isolated.



**Fig. 5.** SRL phases and types of strategies and meta-strategies used, equally distributed for 'Status update' and 'Comment'.

## 6 Discussion

This study examined how L2 learners used SRL strategies and meta-strategies to master their academic writing process. In line with the first research question, students used a range of cognitive, affective and sociocultural-interactive strategies and meta-strategies throughout the writing course, putting major emphasis on the cognitive strategies *activating knowledge* and *reasoning* in their online written discussions. A previous study [14] reported similar findings as student groups engaged in a range of cognitive processing strategies during SRL-based writing instruction. Similar strategies in the current study took up considerable space in conversation threads (with a combined number of about 40%) and could therefore be considered the main 'actors' or 'facilitators' in the language learning process. Nevertheless, since the SRL process is a dialectic course of action [8], it is important to establish how these strategies are embedded within conversation threads, and how they might relate to one another.

In line with the second research question, ENA showed to what degree certain strategies and meta-strategies co-occurred. The results showed that cognitive strategies and meta-strategies are commonly used together in status updates and comments, indicating that students seem aware of the strategies that can be used to complete tasks at hand, and, to a certain degree, seem aware of the reasons why they used them. 'Status updates' feature very little other strategies or meta-strategies, and strategies and meta-strategies do not tend to co-occur often. In the 'Comment' section, more variation in the use of

strategies and meta-strategies has been observed. Also here, cognitive strategies and meta-strategies are prominently co-occurring, albeit to a lesser degree as time went by. The time factor (i.e., by means of the different assignments students had to hand in) demonstrated that the strength of the links between a number of strategies and meta-strategies tends to fluctuate, indicating that the SRL process is a dynamic one. That is, different times and tasks, to a certain extent, require students to apply different strategies and meta-strategies.

Our analysis visualised the dimensions of the SRL process and showed how students can give rise to activating, sustaining and adapting cognition, affect and interaction for academic writing. It has been argued that an adequate interplay between affect and sociocultural-interactive interaction can serve as a basis for a transitional process to improve learning [34]. Harnessing both while supporting learners' cognitive development, therefore, could be an intervention our analysis puts forward.

The findings of this study can be used as a ground to develop adequate and in-time SRL support in the CSCL context of academic writing. For example, selected prompts, adjusted to learners' cognitive abilities, may activate or facilitate students' *identity construction* [35]. Prompting them to, first, reflect on their personal learning goals and expectations, and second, to interact with peers about the learning goals and expectations of others, might give them an understanding of their place within the learning setting. In CSCL contexts, studies have [36] emphasised that providing opportunities for synthesis and reflection is one of the main responsibilities for instructors to maintain a positive, productive learning environment online. Introducing peer feedback or peer collaboration opportunities in the curriculum has proven to be a facilitating factor in language education in this regard, and has allowed learners to explore different aspects of SRL as they can learn from and with others [16]. It is possible to design strategy workshops that focus on students' researching and planning processes in academic proficiency courses or integrate and train peer mentors in writing courses, so students can perform peer review and can get acquainted with the SRL strategies used by peers [37].

## 7 Conclusion and Future Research

In line with the current discussion in learning analytics and quantitative ethnography for SRL, this study has provided novel insights into L2 learners' use of SRL strategies and meta-strategies in a CSCL setting for academic writing, and the interplay between them. This knowledge is important to different stakeholders, including students, teachers and researchers. However, the generalisation of the results should be carefully considered. In future research, scholars need to complement such findings with qualitative data analysis to understand better why students choose specific strategies or meta-strategies over others at different time points of the learning process. Also, it is critical to consider contextual factors such as language proficiency, which may affect the students' use of SRL strategies. Finally, since there are individual differences between students found in other educational contexts (e.g., [38]), scholars are recommended to delve into the examination of students' individual characteristics in the setting of collaborative computer-supported academic writing to be able to offer more personalised writing support in the future.

One direction for future research is to utilise nCoder to investigate automated coding schemes for comparison since we have a basis for coding with the current data set. This

comparison will provide us with an opportunity to examine how tools like nCoder can be used to gain additional insights, and how we apply augmented coding to more data sets from similar ongoing courses.

This study has exhibited how co-occurrences between SRL strategies and meta-strategies in a computer-supported collaborative writing environment can be examined and visualised using quantitative ethnographic methods. Most importantly, it has shown how ENA can help us better understand the SRL process for academic writing as it provides evidence on the roles of cognition, identity construction and motivation.

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