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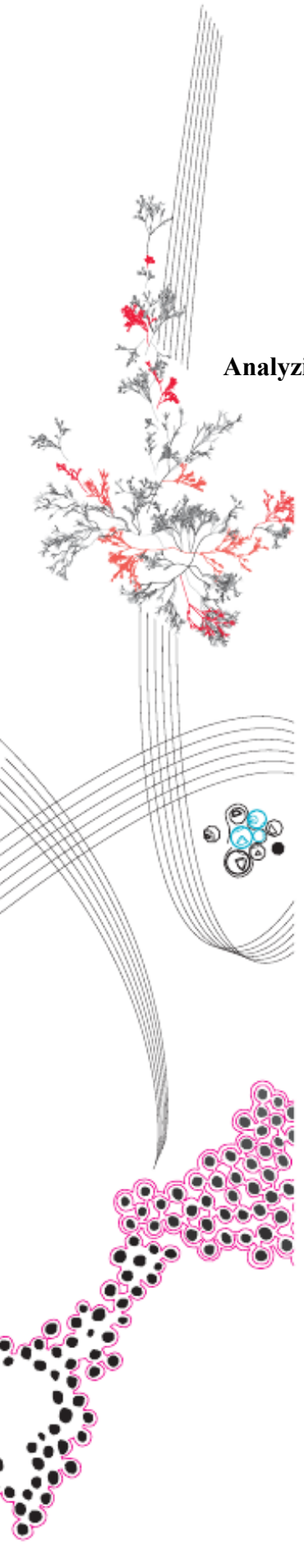

Analyzing Socially Shared Regulation of Learning in a Computer Supported Collaborative Learning setting

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Abstract

Computer-supported collaborative learning (CSCL) has been paid more and more attention to in recent years. Despite the potential of CSCL contexts to enhance learning outcomes, challenges might still arise regarding cognitive, metacognitive, behavioral and motivational aspects of learning. To acquire knowledge through online collaborative learning, these aspects should be collectively regulated, a process known as Socially Shared Regulation of Learning (SSRL). Given that SSRL seems to be an essential skill for effective CSCL and that students often struggle to engage in SSRL within CSCL environments, researchers have emphasized the need for a deeper investigation on how groups regulate and engage in SSRL the context of CSCL. To effectively understand SSRL in CSCL environments, it is crucial to investigate how SSRL manifests and the extent to which students engage in SSRL within an online setting. However, the student's engagement in SSRL and the manifestation of SSRL through CSCL settings has not yet been widely investigated. Hence, this study aimed to investigate how SSRL manifests during student's collaboration in an online setting along with the extent of their engagement in SSRL within CSCL context, focusing on both task regulation and group regulation strategies. This was achieved through qualitative analysis of video data of 10 groups (N=29) of university students when working on a collaborative task. The analysis revealed two main findings. First, group members devoted most of their focus on regulating of task-related activities rather than group regulation strategies. Secondly, SSRL is a scarce process in an online setting. Consequently, this study supports the findings that SSRL needs to be supported in an online setting. Future research should attempt to focus on the ways to effectively support the development of SSRL in CSCL contexts.

Keywords: Computer-Supported Collaborative Learning, Socially Shared Regulation, Regulation, online collaborative learning.

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Introduction

In today's globalized world, information and communication technologies have enabled online learning possible and promising (Gyasi & Zheng, 2023). In recent years, online learning is becoming a more and more essential means of education because it can facilitate collaborative learning (Järvelä et al., 2015). Online collaborative learning supported by computer technologies, known as Computer-Supported Collaborative Learning (CSCL), creates a learning environment that encourages learners to learn at anytime and anywhere (Gyasi & Zheng, 2023). Studies in this field consistently show positive impacts on learning (Zheng et al., 2017), including improved group performance (Cheng & Chu, 2019), and collaborative skills (Vogel et al., 2017).

While CSCL holds the potential to enhance learning outcomes (Gyasi & Zheng, 2023), problems can still emerge at motivational, socio-emotional, cognitive, and metacognitive levels during student's collaboration in the online collaborative environments (Hadwin et al., 2017; Kirschner et al., 2006). Motivational challenges mainly center around variations in personal priorities like competing goals and/or different participation level regarding the group process (Hadwin et al., 2017; Volet & Mansfield, 2006). Typically, these challenges result in decreases in effort, engagement (Järvelä & Järvenoja, 2011), and feelings of isolation during online collaboration (Strauß & Rummel, 2021). According to Liu et al. (2018) and Zheng et al. (2024), learner's engagement and effort is one of the main concerns of online collaborative learning because many learners often become disengaged during their collaboration in an online setting and freeriding can often occur (Liang et al., 2021). Cognitive challenges refer to challenges in achieving shared mental models of the task domain or selecting effective solution paths and strategies (Barron, 2003), which is mainly because CSCL contexts offer limited opportunities for social interactions (Malmberg et al., 2015) as well as other's awareness (Zheng et al., 2023). When group members may not be

aware of each other's perceptions that is crucial to facilitate cognitive aspects related to the group work, it becomes difficult to facilitate the cognitive aspects for effective group work (Malmberg et al., 2015). Socio-emotional challenges involve difficulties in achieving a positive climate such as problems related to establishing psychological safety, effective communication, and navigating power relationships (Näykki et al., 2014). Socio-emotional challenges may arise when group members engage in dysfunctional communications such as lack of commitment (Malmberg et al., 2015), disrespect and/or corrective behavior (Hogenkamp et al., 2021). Research believed that students often feel uncertainty and socio-emotional challenges during online collaborative learning (Hod & Katz, 2020; Mäkitalo et al., 2005). Metacognitive challenges, in turn, involve difficulties in monitoring, evaluating, and reflecting on group processes, outcomes, and progress in an online collaborative setting (Janssen et al., 2012; Zheng et al., 2024). Metacognitive challenges partially resulted in limited interaction during online collaborative activities (Khalil & Ebner, 2014) and/or the lack of immediate non-verbal clues (Walther, 2011), offered by online environments. Hence, studies have identified that regulation of social interaction in digital environments presents different characteristics and encounters more challenges compared to face-to-face learning that may affect student's regulation learning process (e.g., Janssen & Kirschner, 2020; Su et al., 2018; Wu, 2015), which can lead to several consequences for the learning process. For example, setting goals, monitoring and controlling, and reflecting and evaluating becomes less likely (Malmberg et al., 2015; Zhang et al., 2021), which in turn reduces on-task behavior and a loss of task focus (Hogenkamp et al., 2021; Linnenbrink-Garcia et al., 2011). Beside these challenges, individual differences and diversity among group members further complicate online collaboration because students bring varying perceptions, goals, and engagement levels in online collaborative process (Splichal et al. 2018; Zheng et al. 2019). Therefore, given the concurrent nature of CSCL, wherein group members often lacking

awareness of each other's perspectives (Schnaubert & Bodemer, 2019) and diversity among group members, along with motivational, socio-emotional, cognitive, and metacognitive challenges that learners encountered in online learning settings, it is crucial for group members to develop appropriate regulatory strategies to address these challenges (Splichal et al., 2018; Zheng et al., 2021). This necessitates that students collectively regulate and adjust their cognition, metacognition, behavior, and motivation, a process known as Socially Shared Regulation of Learning (i.e., SSRL; Panadero & Järvelä, 2015). SSRL facilitates better decision-making and enhances team interaction, ultimately improving learning outcomes (Hadwin et al., 2017).

Over the past decade, interest in understanding regulated learning within collaborative learning contexts has grown (Volet & Vauras, 2012). Research has primarily focused on task regulation for cognitive aspects of learning and collaboration (Isohätälä et al., 2020) and how various types and strategies of regulation enhance productive collaborative learning (e.g., Isohätälä et al., 2020; Malmberg et al., 2017). There have also been some studies focused on enhancing, recognizing and improving collaboration skills through reflective scripts or specially designed online reflective tools (e.g., Borge et al., 2018; Eshuis et al., 2019). Moreover, recent studies have mainly focused on the fluctuations of social regulations in face-to-face settings (e.g., Isohätälä et al., 2018; Näykki et al., 2017; Rogat & Adams-Wiggins, 2015).

What has not been clearly investigated is that how SSRL might manifest in CSCL contexts, under which circumstances regulatory actions occur in an online setting (Järvelä et al. 2019), and how groups engage in and productively regulate collaborative social processes in CSCL environments (Gyasi & Zheng, 2023; Järvelä & Hadwin, 2013; Järvelä et al., 2010; Kirschner & Erkens, 2013; Molenaar & Järvelä, 2014; Sjølie et al., 2022). Hence, as SSRL seems to be a necessary skill for effective CSCL (Hadwin et al., 2011) and as it is challenging

for students to engage in SSRL in CSCL environments (Zheng et al., 2024), researchers have agreed that more in depth investigation is needed regarding SSRL in the context of CSCL (e.g., Järvelä & Hadwin, 2013). For future studies to create effective support for SSRL within CSCL environments, it is crucial to understand how SSRL manifests and to what extent students engage in SSRL in online settings, as it may differ significantly from face-to-face interactions, potentially making it more challenging to perform. This understanding will guide the development of targeted support strategies to enhance SSRL in CSCL environments. Therefore, this research study aimed to understand the extent of student's engagement in SSRL, along with investigating how SSRL manifests through students' engagement in both task regulation and group regulation within the context of CSCL.

Theoretical Framework

Collaborative Learning

Collaborative learning (CL) refers to the process in which two or more individuals work together to share insights and knowledge, collectively building understanding with the aim of reaching a common goal(s) (Krause et al., 2009; Laal et al., 2012; van der Meij et al., 2011). In such learning situations, students engage in group-based learning activities, while instructors usually serve as facilitators (Kirschner, 2001). Zheng et al. (2023) argued that collaboration among learners is beneficial as it fosters interactions such as knowledge building (Bereiter & Scardamalia, 2003), students' learning achievement (Chen et al., 2018; Jeong et al., 2019), and positive conflict resolution (Fischer et al., 2013).

Although collaboration has the potential to foster learning, it is not easy (Malmberg et al., 2015) and research has shown that groups encounter a wide range of challenges during their collaboration (e.g., Kreijns et al., 2003; Phielix et al., 2011). This is likely because the collaborative process demands groups to handle various tasks while coordinating between

multiple individuals with unique perspectives as they strive to achieve a collective understanding in a joint task (Dillenbourg, 1999; Roschelle & Teasley, 1995). Hadwin et al. (2010) believed that to collaborate effectively, students need to engage in discussions of the task to attain mutual understanding (i.e. engage in “task analysis"), set up plans and goals for task completion (i.e. engage in “planning”), verbalize and openly exchange task perceptions as well as justify their strategies (i.e. engage in “elaboration”), and conflict to maintain shared understanding and commit themselves to the teamwork (i.e. engage in “monitoring”). Additionally, Winne et al. (2013) believed that effective collaboration requires all group members to successfully regulate their own learning and help other group members in collectively regulating learning.

Computer-Supported Collaborative Learning

Nowadays, technology has been widely utilized to provide distance education, prompted by the COVID-19 pandemic, to facilitate the co-construction of knowledge among learners of all age groups (Zheng et al., 2024). One of the recent practices of using technology in higher education is Computer-Supported Collaborative Learning (CSCL). CSCL is an effective teaching method that emphasizes learning with the help of computers (Janssen & Kirschner, 2020). Based on Zheng et al. (2023), CSCL offers unlimited possibilities to communicate with peers and collectively build knowledge wherever and whenever learners want. They believed that the advantage of CSCL has been widely documented in recent studies in compared to face-to-face learning, including improved group performance (Cheng & Chu, 2019), enhancing communication and collaborative skills (Vogel et al., 2017), promoting knowledge building (Zheng et al., 2022), and high-order abilities (Fu & Hwang, 2018), which can be leveraged through various ways, including text-based interactions and video-call meetings (Muñoz-Carril et al., 2021; Pineli, 2021). Regardless of the format, to achieve productive discussions in an online collaborative setting,

students need to regulate their learning by employing strategies for better understanding, assisting peers, managing learning processes, negotiating goals, sharing responsibilities, and adapting strategies to motivate group members towards achieving learning objectives (Järvelä & Hadwin, 2013).

Yet, studies reveal that when students attempt to collectively regulate their learning activities, the technology-mediated collaborative learning environments may present unique challenges (e.g., Hadwin & Oshige, 2011; Zheng et al., 2023). These challenges primarily arise from the difficulties in perceiving and processing other group members' participation and social presence during communication, negotiation, and monitoring of responses through a technological interface (Janssen & Bodemer, 2013; Lee et al., 2015; Malmberg et al., 2015). According to Zheng et al. (2021), a further issue involves students' regulatory skills within CSCL context, particularly their skills at the group level. Many students lack the necessary regulatory strategies for collaborative tasks, such as failing to be aware of each other's goals and progress of knowledge building (Zheng et al., 2023), or interact productively in groups, and actively monitoring and supporting each other's regulation through questioning and prompting in technological environment (Miller & Hadwin, 2015). Also, learners often struggle to improve and refine knowledge during CSCL (Chen et al., 2021). In addition, in the context of CSCL, learners cannot employ contextual cues like body language effectively, making it difficult to know the meaning behind others' comments on their postings (Kopp et al., 2012).

Hence, Järvelä & Hadwin (2013) suggested that simply dividing students into groups and offering online collaborative tools is not adequate for maximizing learning outcomes and collaborative knowledge construction, which mainly because students often struggle to regulate their learning, both individually and as a group in CSCL settings (Järvelä & Hadwin, 2013). Besides that, Kopp et al. (2012) emphasize that online group discussions demand even

more regulation than face-to-face interactions, due to the need for participants to develop new communication and collaboration skills. Therefore, effective CSCL requires structured regulation and support to help groups to reach their full potential (Dillenbourg, 2016).

Socially Shared Regulation of Learning

Collaborative learning frequently presents challenges that requires regulation to ensure the learning process remains effective in accomplishing the task (Hadwin et al., 2022; Koivuniemi et al., 2018). Socially Shared Regulation of Learning (SSRL) encompasses the regulation of shared activities, involving collectively or interdependently shared regulatory processes, knowledge, and beliefs to achieve a common goal (Hadwin et al., 2011). Throughout this process, new ideas may shape, and divergent ideas may be shared, discussed, and either incorporated or disregarded (Järvelä et al., 2018). In addition, Järvelä & Hadwin (2013) believed that SSRL does not necessarily demand sameness in thoughts among group member, but instead it highlights the processes of negotiation towards sameness when each member actively contributes to shaping a joint perception of the task or devising strategies to achieve common goals. For SSRL, four key categories—metacognition, cognition, motivation, and behavior—need to be collectively regulated. Students, for example, adapt their utilization of motivation regulation strategies to address a particular challenge faced within the group situation (Kirschner et al., 2018). In this situation, they communicate one's strengths, weaknesses, and preferences, enabling them to understand what other's mean and taking the perspective of other students (Järvelä et al., 2018). Therefore, the attained level of SSRL can be influenced by who regulates, what aspects are being regulated, and when the regulation occurs (Järvelä & Hadwin, 2013). Groups engaging in SSRL, perceive the tasks as less difficult (Hurme et al., 2009), and achieve better learning outcomes compared to groups without SSRL or with lower levels of shared regulation (Volet et al., 2009).

Task regulation and Group regulation

In the context of collaborative learning, SSRL can be divided into task regulation and group regulation (Hogenkamp et al., 2021; Järvelä & Hadwin, 2013), both of which are crucial for SSRL (Hadwin et al., 2011). Task regulation refers to the processes involved in regulation of motivation, cognition, and metacognition activities required to complete the task, which includes planning, monitoring, evaluating, and motivation (Hogenkamp et al., 2021). On the other hand, group regulation involves the regulation of social interactions and group dynamics such as complimenting each other, which can enhance the group member's engagement (Abedin et al., 2012), group performance, and learning satisfaction (Muilenburg & Berge, 2005). Järvelä and Hadwin (2013) believed that without proper regulation of social aspects, the group's performance may decline. However, regulatory processes have usually been examined from task perspective (e.g., Fransen et al., 2013; Hmelo-Silver & Barrows, 2008; Weinberger et al., 2007; Zhang et al., 2007). Hence, the study by Hadwin et al. (2017) indicates that, when developing a model of SSRL, the researcher should also consider the interplay of both task-related and social activities. Therefore, it is important to not only focus on domain-related interactions as shared task-regulation can result from social interactions (Hadwin, et al., 2017; Hogenkamp et al., 2021) and effective regulation of social interaction should not be taken for granted (Hernández-Sellés et al., 2020; Muñoz-Carril et al., 2021). According to Isohätälä et al. (2017), effective social interaction is a fundamental requirement and necessary for the emergence of SSRL.

Other Regulations in compared to Socially Shared Regulation

Beyond just applying regulatory strategies socially, in the context of collaborative learning there are two other types of regulatory strategies, including Self-regulation (SR) and Co-regulation (Co-R; Hadwin et al., 2011; Zhang et al., 2021). Students who have strong self-regulation skills demonstrate superior abilities compared to novices in several key areas:

(1) they excel in monitoring their problem-solving processes, (2) better estimating task difficulty, and (3) displaying heightened awareness of errors in their work (Matlin, 1994). What distinguishes SSRL theory from other theories, centered on individual self-regulated learning, is that SSRL focuses not only on cognition and metacognition, but also on reciprocal roles of motivation, behavior, and emotion within the group (Zimmerman, 2011), which are regarded as the more social dimensions of learning (Hogenkamp et al., 2021). Moreover, research by Panadero & Järvelä (2015) emphasized the importance of distinguishing between Co-RL and SSRL. They noted that the term Co-RL is sometimes used when SSRL is described. Co-RL involves group members regulating each other's learning, instead of sharing the regulatory process, which happens in SSRL (Hogenkamp et al., 2021). All in all, the advantages of SRL and Co-RL for individual's learning have been clearly evidenced (e.g., Zimmerman, 2011), but since learning occurs increasingly in interactive settings, it is necessary to investigate regulatory processes beyond the individual which is SSRL (Hadwin et al., 2011; Järvelä & Hadwin, 2013).

Socially Shared Regulation of Learning in the Context of Computer- Supported Collaborative Learning

When students carry out collaborative learning in an online setting, they experience problems in both regulating the task and the group dynamics (Kreijns et al., 2013). In addition, in many cases students do not seem to exhibit the skills as expected (Gunawardena et al., 1995; Puntambekar, 2006). Accordingly, Salomon & Globerson (1989) noted that "Teams just do not always function as well as they could or as well as one would have expected them to" (p. 90). For example, when students utilize computer-mediated communication for collaborative tasks, they typically spent greater time and effort compared to those in traditional face-to-face environments to regulate group activities (van der Meijden & Veenman, 2005). Furthermore, group members may lack awareness of each other's task

perceptions or objectives, which is mainly because CSCL offers limited opportunities for socio-emotional interactions within the group during their online collaboration (Sedrakyan et al., 2020). In addition, learners fail to plan adequately, utilize adaptive learning strategies, and/or leverage technologies for learning, collaboration, and problem-solving (Järvelä & Hadwin, 2013; Kirschner & van Merriënboer, 2013; Zimmerman, 2011). These challenges are unique to the CSCL environment due to the reliance on technology-mediated communication, which can limit the perception and processing of social cues and hinder effective interaction (Janssen & Bodemer, 2013; Lee et al., 2015; Malmberg et al., 2015). Therefore, the concept of socially shared regulation becomes important in the context of CSCL.

In response, students need to activate appropriate SSRL strategies specifically tailored to address these CSCL challenges (Järvelä et al., 2015). For example, in online situations wherein group members do not interact effectively or in a friendly manner due to the lack of face-to-face cues, it may be necessary to engage in planning and monitoring regulation strategies at the group level (Strauß & Rummel, 2021), which can promote high-quality regulatory processes (Rogat & Linnenbrink-Garcia, 2011). Moreover, if students perceive a situation as challenging due to difficulties in expressing ideas and/or a lack of commitment exacerbated by the limited social presence online, they can utilize motivational regulation strategies through the negotiation process, enhancing their sense of togetherness and commitment (Järvenoja et al., 2013; Kirschner et al., 2018). However, if motivational challenges remain unresolved within CSCL context, students may struggle to align with task demands unless socio-emotional balance is restored among group members, which can be particularly challenging in a virtual environment (Näykki et al., 2014). Ultimately, the effectiveness of SSRL strategies in CSCL contexts depends on the group's ability to adapt their regulatory strategies to the unique demands of technology-mediated collaboration.

Research Questions

This research study aimed to clarify how SSRL manifests in CSCL and to what extent students engage in SSRL. Two main research questions of the current study are:

RQ1: To what extent do university students engage in socially shared regulation of learning in a computer-supported collaborative learning setting?

RQ2: How socially shared regulation of learning was manifested by university students in a computer-supported collaborative learning setting?

To address the main research questions following sub-questions are stated:

RQ1a: To what extent do university students in a group engage in task regulation strategies in a computer-supported collaborative learning setting?

RQ1b: To what extent do university students in a group engage in group regulation strategies in a computer-supported collaborative learning setting?

RQ2a: How socially shared regulation of learning was manifested by university students in terms of task regulation in a computer-supported collaborative learning setting?

RQ2b: How socially shared regulation of learning was manifested by university students in terms of group regulation in a computer-supported collaborative learning setting?

Method

Participants

In total, 30 students (8 males, 22 females, $M = 27$, $SD = 4.24$, ranging from 18 to 38 years old) involved in either a Bachelor's or Master's program were recruited to participate in this study. Out of 30 participants, 29 participants were present during the online group meetings (one person did not attend in the scheduled online meeting). This allocation aligns with the argument by Crouch & McKenzie (2006) that in exploratory research, smaller case studies, can significantly improve the depth and validity of the investigation. The participants

were selected through convenience sampling by using the personal network of the researcher. This sampling method was chosen because it is well-suited to address the research questions and offers time and cost effectiveness. Thus, the selection criteria for this study entailed participants being university student and their willingness to take part in this research study. This focus ensures that participant have prior knowledge of computer networks, consistent their English proficiency levels for collaboration, and their accessibility.

All participants were randomly assigned to groups of three members according to their free time and their preference. Therefore, in total 9 groups of three students and one dyad participated in this study. Two documents were sent via email to the 30 participants. The first was an online consent form created by Qualtrics along with an information sheet detailed of the assignment, data collection process, confidentiality measures, potential risks and benefits, and participants' rights. All participants agreed with the terms of this study by submitting the consent form, after it being approved by the ethics committee of the university where the study was conducted.

Collaborative Task

The current study employed several digital tools to collect and analyze video data obtained from online group meetings. Microsoft Teams was used to facilitate the online meetings and serves as the primary platform for data collection. This platform is chosen for its widespread use, recording feature, and ability to engage participants regardless of their location.

A collaborative task was designed to understand how SSRL manifests through students' discussions in an online environment and to analyze their engagement in SSRL within this setting. The task involved a storyboard and its associated rules, which were presented on two separate pages, designed by Padlet platform. Students were asked to create a story using the

designed storyboard, while making sure to incorporate all the required rules into their narrative.

Padlet

The aim of using Padlet in this study was to facilitate active student engagement and collaborative learning through an online platform. This is in the line with findings by Deni & Zainor (2018) who noted that Padlet facilitates an active exchange of ideas and enables students to construct and reconstruct ideas. In this research, Padlet was chosen for its ability to integrate pictures and facilitate interactive communication and collaboration among participants. This platform integrates various categories like collections, activities, announcements, and communications, Specifically, in the context of current study, the category of communication was employed to facilitate the collaborative task. The selection of Padlet was mainly based on its main feature. Padlet is able to support commenting and editing by multiple users at the same time ensured that students could engage in continuous dialogue and collaborative experience during their online meetings.

Totally, two Padlet pages were utilized to design the rule page and storyboard for this study. The section bellow provides detailed information regarding these two pages.

Rule Page

To structure information sharing among group members and to ensure that participants are familiar with the various rules and guidelines involved in the assignment, the rule page was designed, using Padlet platform. This page consisted of five distinct rules and/or guidelines that needed to be incorporated into the participant's story, see Figure 1.

The first rule *Storyboard's Pictures* provided participants with information about the storyboard's pictures. It specified that the story must include at least eight pictures of the storyboard and informed participants about the option to zoom in for a closer view by clicking on each picture in the storyboard. The purpose of this rule was to stimulate groups to

interact more by using a greater number of pictures in their story to ensure sufficient data for analysis.

The second rule *Specifying Character, Title and Genre* asked students to introduce five characters, each with a name, into their story. Additionally, they were required to select a genre, such as comedy, drama, or mystery, and choose a title for their story. The aim of this rule was to ensure a structured story and encourage creativity in developing characters and themes collaboratively. By encouraging to add additional details, greater collaboration among group members was required. Ultimately, this facilitated knowledge construction and idea sharing.

The third rule *Adding Comment or Numbers* served more as a guideline than a strict rule for participants. This was done by giving a hint which stated that they could add their comment or numbers on the comment box under each picture to specify the order of the pictures in their story. This guideline aimed to guide participants on how to specify the order of the pictures in their story and arranging them in a sequence that they thought is best fit for their story.

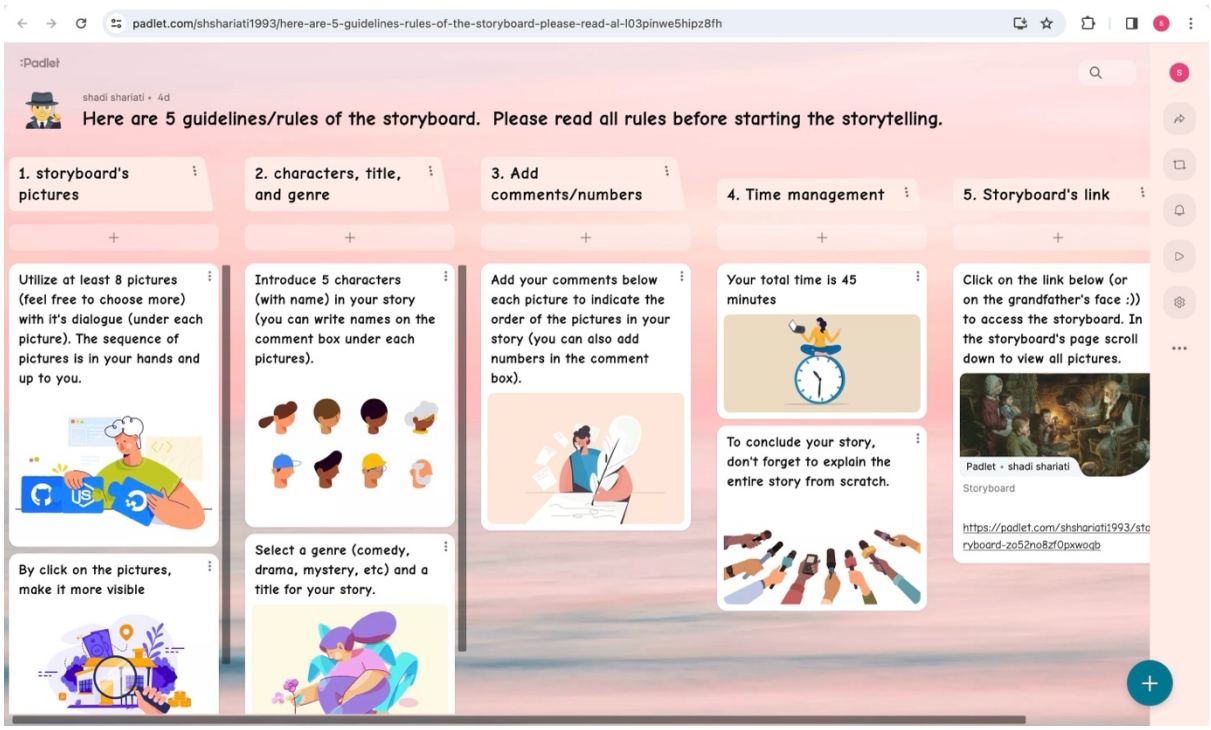
The fourth rule *Time Management and Explaining the Story* was chosen to remind participants to adhere to the timeline and to explain the entire story from the beginning. This rule had two main aims. First, by explaining the story from scratch, students were indirectly encouraged to actively engage in the storytelling process, this approach not only fostered a sense of responsibility, but also encouraged them to assume control of the narrative, thereby enhancing their understanding regarding their story. Moreover, adhering to a timeline requires students to engage consistently and manage their time effectively, which naturally involves active participation. By controlling the time, students committed to collaborate and communicate regularly to meet their collective goals, thereby enhancing their involvement and responsibility in the storytelling process.

Storyboard's link was the final rule. Participants were provided with a link to the storyboard, which directed them to the storyboard's page upon clicking.

All in all, all rules were designed in attractive manner to stimulate participants for more collaboration and make the task more engaging for them. This was done by making use of different colors, relevant pictures and themes.

Figure 1

Rule page



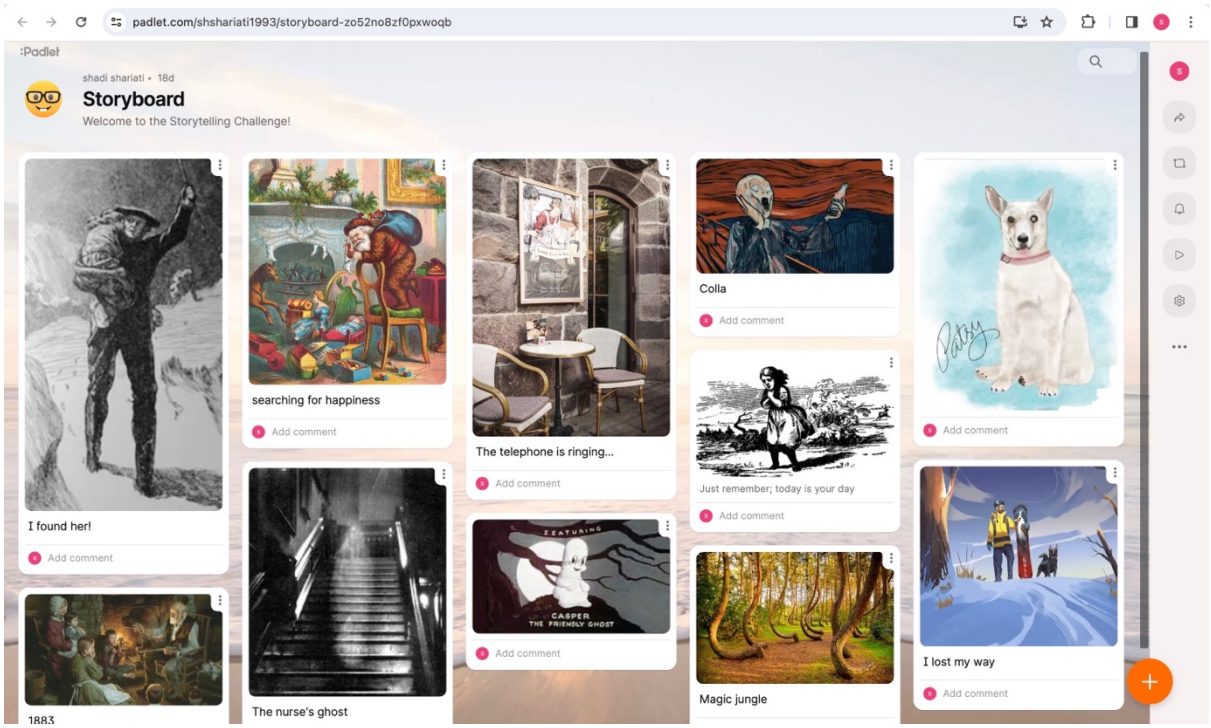
Storyboard

The storyboard page aimed students to construct and share their ideas about the pictures and creating the story by editing and organizing content collaboratively. According to Megawati and Anugerahwati (2012), storyboarding aids in word retrieval and idea generation. Moreover, Bruce (2011) believed that storyboarding enhances students' abilities in planning, outlining, brainstorming, and elaborating. Therefore, storyboarding was chosen as a structured framework to facilitate group discussion in this study.

In this research study, the storyboard functions as a collaborative assignment by which the engagement of students in SSRL within an online setting, were analyzed. It consisted of 11 distinct images deliberately presented without a predetermined sequence, aiming to stimulate greater interaction and collaboration among participants, see Figure 2. Pictures were chosen in abstract, real-time, and fun formats to evoke diverse interpretations. Each picture was accompanied by a caption and a comment box below it. Participants used the comment box to type down their notes or numbers. These comments served as participants' notes to specify the sequence of the pictures of their story and to ensure they remembered the agreed-upon events happened in each picture. In addition, below each picture a caption like 'The telephone is ringing...' were mentioned to stimulate students' thinking and collaboration on how to incorporate the caption into their story, ultimately encouraging for more collaboration. It should be noted that it was not required the participants to write down their story, instead they were asked to explain their story from the beginning, in rule 4 (Figure 1). Moreover, the link to the rule page was mentioned at the top of the storyboard page to prevent confusion when students want to check the rules again.

Figure 2

Storyboard



Procedure

Participants were invited to take part in this research study. Once they verbally expressed their willingness to participate in the study, they received the information sheet and consent form's link via email, detailing data-collection process, confidentiality, and the voluntary nature of their participation. The right to withdraw of participation was also emphasized. Moreover, they were not informed of the study's main purpose before or during the online meeting to prevent bias in their responses. Instead, they received this information via email after the study is completed.

After submitting the consent form, using Qualtrics, each member in the group received a Teams invitation's link to join the study one day before the online group meeting. Once accessing the link and to execute the main task, the researcher presented a brief oral explanation to the participants, giving information regarding the main task to review the process and understand the assignment better.

This was followed by the link to the rule page which was displayed to the participants in the chat. Once sharing the link, no additional guidance or feedback was given to facilitate group collaboration. After the participants read the rules of the assignment, by clicking on the storyboard's link, provided in the last rule, they were able to start sharing their ideas and make their story. Finally, after finishing each online group meeting, a screenshot of the Padlet page was saved. Subsequently, the Storyboard was cleared of all participant's notes to prepare it for the next group.

The collaborative storytelling assignment needed to be completed within a total timeframe of 45 minutes after sharing the rule page's link. If the group members did not adhere to the time limitation, they did not address the rule number 4, but no penalties were considered for them. It is important to note that there were two groups that completed the task beyond the 45 minutes.

Data analysis

The analysis of student's discussions was carried out by analyzing how they collaboratively regulate their discussion towards the completion of the task, as the aim of this study was to understand the extent of student's engagement in SSRL as well as the manifestation of SSRL in a CSCL setting by focusing on both task regulation and group regulation strategies. It should be noted that before the main data collection, a pilot test involving 3 volunteers was conducted to assess the feasibility and clarity of the study procedure and to address any potential issues related to participant comprehension. The pilot test aimed to ensure that the instructions and rules were clearly understood and to identify practical issues in the study's implementation. Based on the pilot test findings, no changes were needed for the Padlet pages, as they were found to be clear for participants.

In the current study, the coding scheme developed by Hogenkamp et al. (2021) was used to analyzed the video data of online group discussions. The coding scheme aimed to measure

the four constructs of SSRL including metacognition, cognition, behavior, and motivation by making a distinction between two main types of regulation including task regulation and group regulation. Table 1 provides the categories, subcategories, codes, and their descriptions of each code related to SSRL in Hogenkamp et al. (2021) study. Moreover, this table shows the examples of each code, which was performed by students who initiated a certain SSRL activity during online collaborative meeting in the context of current study.

Following the online meetings, the recorded video data were coded using ELAN software. Using ELAN software ensured that there was no need for generating the video transcripts, so the coding process was conducted directly by coding the video data. This process was done by adopting steps taken by Hogenkamp et al. (2021) who defined 'segments' as a set of speaking turns, taken by students during discussions. A 'segment' represented a speaking turn, and started when a student starts the conversation and ended when the student finished, when another student start speaking, when the student was interrupted, or when there was a silence lasting more than two seconds (Hogenkamp et al., 2021). Initially, student's discussions were segmented through each video data and then the process of coding started by identifying SSRL codes among all segments, enabling the allocation of statements to the four main categories of the coding scheme and their related sub-categories. This was done by determining the specific SSRL code which was performed by students in a group. It is worth mentioning that when two or more different patterns of SSRL were observed during a student's conversation, it was split up into multiple segments. Utilizing segments is appropriate for data that presents fundamental empirical challenges (i.e. the measurement of SSRL) as this process allows researchers to stay open to the data and observe small nuances (Charmaz, 2006).

After completing the qualitative coding by means of ELAN software, the data was quantified to assess the extent to which SSRL occurs regarding the group and task regulation.

This process allowed for the identification of how frequently SSRL codes were observed. Consequently, the frequencies of SSRL occurrences were computed. To examine how SSRL manifests itself regarding both task regulation and group regulation, specific examples and patterns of each SSRL skill were identified through the student's discussion in the group. Moreover, regular reviews were conducted, ensuring coding quality and alignment with the four coding categories. After coding 10% of the video data, the interrater reliability coefficient (i.e., Cohen's κ) was calculated. The Cohen's Kappa showed good interrater reliability (k = .76).

Table 1

The four categories of SSRL, subcategories, codes, descriptions and examples

Category	Type of regulation	Codes	Descriptions	Examples
Metacognition	Task-regulation	Goal setting	Stablishing or discussing the goals for the task	"We should tell a story with five persons"
		Task planning	Arranging specific action, not specifically assigned to a certain person, needs to be performed at a certain point of time	"I think we maybe first select the genre, and then we can pick the pictures that fit with in those"
		Monitoring task progress	Monitoring the progress of the task	"We are at the third rule now."

Table 1 *Cont.*	Monitoring task performance	Monitoring how well the group is performing regarding the task	"I like it how we came up with the name"
	Monitoring comprehension	Monitoring whether the group understands task-related comments or information within the group	"Do you know what I mean?"
	Task perception	Discussing the difficulty of or attitude towards it	"The names are the easiest part, even we can give name at the end"
	Evaluating task outcomes	Evaluating the task's outcome	"Do you agree with writing the comment in the comment box?"

Table 1 *Cont.*	Group-regulation	Coordinating collaboration	Arranging task among group members	"What if we start with one of us, and the second person try to do other pictures to make the fellow of the story?"
		Monitoring group performance	Monitoring how well the group is performing regarding the collaborative aspects	"The way we are doing is perfectly fine"
Cognition	Task-regulation	Problem-solving strategy	Establishing or discussing about learning strategies for the task	"Can one of you share the screen, so it would be easier for us to collaborate"

Table 1 *Cont.*		Verifying	Asking the group members whether the provided information is accurate	"So, we take 'I lost my way' picture as the second picture? Right?"
Motivation	Task-regulation	Stimulating task focus	Stimulating group members to refocus on the task when they become disengage from it	"Would you mind to stay back to the telephone is ringing, and who is talking on the telephone, and what they are going to tell?"
		Praising	Making positive feedback about other's ideas	"I like this idea for sure"
Behavior	Group-regulation	Inclusion	Encouraging participation of group members by asking for ideas and engaging them in the task	"What do you think *Student's name*?"

Table 1	Disrespect	Making negative comments about
Cont.		group members or engaging in
		behaviors that may be perceived as
		bullying or annoying.
	Correcting	Controlling the group member's
	behavior	behavior

Results

Introduction to Results

In total 2505 segments were coded which included the video data of ten groups, with a minimum of 133 segments and a maximum of 443 segments per group. Out of all segments (i.e., 2505), 691 segments were coded regarding SSRL. It should be noted that all frequencies were computed with the SSRL codes (i.e. 691). Table 2 and 3 indicate the relative frequencies (percentages) of each code and subcategory of SSRL in the context of CSCL of current study.

Table 2

Mean scores, minimum, maximum scores, standard deviations, and percentages of SSRL per code

Category & Subcategory	Code	M_{Group}	Min	Max	SD	Relative Frequency (% of All Codes)	Groups Performing Behavior (%)
Metacognition							
Planning	Goal setting	6.5	2	10	2.59	9.41	100
	Task planning	17.7	7	37	8.74	25.61	100
	Coordinating collaborating	2.2	0	4	1.32	3.18	90
Total planning		26.4	16	47	9.95	38.2	100
Monitoring	Monitoring task progress	9.4	4	16	4.4	13.6	100
	Monitoring task performance	0.4	0	2	0.84	0.58	20

Table 2 *Cont.*	Monitoring comprehension	1.2	0	3	1.03	1.74	70
	Monitoring task perceptions	3.4	0	13	4.4	4.92	60
	Monitoring group performance	0.1	0	1	0.32	0.14	10
Total monitoring		14.5	6	31	7.72	20.98	100
Evaluating	Evaluating task outcome	2.2	0	6	2.3	3.18	80
Total evaluating		2.2	0	6	2.3	3.18	80
Total metacognition		43.1	29	78	17.16	62.37	100
Cognition							
	Learning strategies	5.1	1	10	3.41	7.38	100
	Verifying	10.5	3	20	4.77	15.19	100

Table 2

Cont.

Total cognition		15.6	7	30	7.06	22.57	100
Behavior							
	Inclusion	4.1	0	11	3.6	5.93	80
	Disrespect	0	0	0	0	0	0
	Correcting behavior	0	0	0	0	0	0
Total positive social interactions		4.1	0	11	3.6	5.93	80
Total negative social interactions		0	0	0	0	0	0
Total behavior		4.1	0	11	3.6	5.93	80

Table 1

Cont.

Motivation							
	Simulating task focus	1.2	0	4	1.23	1.74	70
	Praising	5.1	1	10	2.85	7.38	100
Total motivation		6.3	2	11	2.67	9.12	100

Note: The 'groups performing behavior' represents the percentage of groups where each code was observed at least once. The ratio to the total amount of codes is computed as the percentage of the total number of codes (N = 691).

Table 3

Mean scores, minimum, maximum scores, standard deviations, and percentages of SSRL per sub-category

Category	M_{Group}	Min	Max	SD	Relative Frequency (% of All Codes)	Groups Performing Behavior (%)
Task planning	10.31	14	46	24.2	35.02	100
Group planning	1.31	0	4	2.2	3.18	90
Task monitoring	7.49	6	30	14.4	20.84	100
Group monitoring	0.31	0	1	0.1	0.14	10
Task evaluation	2.3	0	6	2.2	3.18	80
Task cognition	7.05	7	30	15.6	22.58	100
Positive social interactions	3.6	0	11	4.1	5.93	80
Negative social interaction	0	0	0	0	0	0
Task motivation	2.67	2	11	6.3	9.12	100

RQ2a; Investigating the Manifestation of SSRL in terms of Task Regulation Strategies in a CSCL setting

Metacognition

In this research study, it is evident that metacognitive strategies including planning, monitoring and evaluation, were typically employed across all groups (62.37% of all SSRL codes, $M = 43.10$, $SD = 17.16$). However, certain sub-codes within this category were infrequently used or even entirely absent in some groups.

Task planning

Goal setting. In the current study, goal setting accounted for 9.41% of all SSRL codes ($M = 6.50$, $SD = 2.59$). Since the task consisted of four rules, goal setting often happened when students prepared for each rule, or when the group members wanted to gain more understanding of the certain goal of the task. For example, in the online collaborative meeting of group 2, after students spent some time to read the rules of the assignment, student 1 explained the goal of the assignment to the group. For more clarification on goal setting, this example is provided in Figure 3 in more details.

Figure 3

Example of goal setting

Student 1: “I finished reading”
Student 2: “Yeah, me too”
Student 3: “Me too”
Student 1: “So, we do have a lot of pictures” * Looking at face of others*
Student 2: “Hhhhmmm”
Student 1: “So, we should tell a story with five persons”

Task planning. In this study, around a quarter of all SSRL codes (25.61%) accounted for *task planning* ($M = 17.70$, $SD = 8.74$). As an example of task planning of group 8, almost at the beginning of online meeting and when students read all the rules collaboratively, they

engaged in task planning by discussing on what actions need to be done first and how they should proceed upon knowing. Student 2 shared her thoughts on the logical sequence of the pictures. This example is provided in Figure 4.

Figure 4

Example of task planning

Student 2: “I think we maybe first select the genre and then we can pick the pictures that fit with in those.” Student 3: *Nodding head* “Ok” Student 1: “The characters or the pictures first?” Student 2: “like if we wanna to make it comedy or drama or mystery or something like that” Student 1: “Ohhh the genre ok”

Totally, the subcategory of task planning (i.e., goal setting and task planning) was a quite frequently used metacognitive strategy during online collaborative learning meetings (35.02% of all SSRL codes, $M = 10.31$, $SD = 24.2$).

Across all groups, several patterns of the subcategory task planning were indicated by students. Mostly, the first step of task planning was typically involved reading the rules and discussing the task directions, and six groups spent some time to do this plan. In these cases, students often paused after reading each rule to plan how to complete the next step and discussed what actions needed to be done in the time that they have already been there. At this point, task planning primarily involved deciding what part of the task to address first. The second pattern of task planning strategy, observed in three groups, was that group members first agreed on a clear plan and then they used this plan to guide their work on the task. This approach allowed students to start the task and then refer back to the shared plan as they wanted to monitor their progress on the task. For example, in group 4, after all members read the rules, they decided on the genre, title, and number of characters, even naming the

characters of their story before starting the process of storytelling. In this case, they paused mid-way through the task to review the group plan or consult the task directions. Moreover, task planning strategy was also found when students assessed the remaining time relative to the total time of the task. Instances of reminders include phrases like, “I think we have about a minute or two left”. The other pattern, which was evident in just one group, was that when students in the group simply read the rules of the assignment and they had little discussion about the task’s directions. This means that group members did not engage in conversations regarding the rules of the assignment, and they directly started to work on the assignment. For example, in group 1, it was evident that group members did not attend to the rules comprehensively. In this case, some rules like ‘including the captions in the story’ were ignored and was not addressed.

Particularly, examples of the subcategory of task planning which can specifically be attributed to CSCL context, were also observed. For instance, during the collaborative meeting of Group 4, Student 1 shared her screen from the beginning of group meeting. Toward the end of the meeting, when Student 3 aimed at explaining the story from scratch, she asked student 1 to make the screen bigger. She said, “My screen is really small, could you make is a bit bigger?”. In response, during student 3’s explanation, Student 1 made each picture full screen to accompany Student 3's explanation. Moreover, particular regulation strategies regarding goal setting which specifically can be attributed to CSCL, were also observed. For example, in group 4, when group members aimed to specify their goals, Student 1 opened a new Word document to type out different goals for the assignment, such as the title, genre, and characters. Then, for each goal of the assignment, she typed the collaborative task-related outcomes next to each part. Similar pattern was observed in group 3. When students were struggling to find a suitable place for typing the genre and title of their story, student 1 found an option of the Padlet that allowed them to open a new comment box

in the storyboard. She said that “Wait, wait there is a plus”. After applying the comment box, she typed out the task-related dimensions on it.

Task monitoring

Monitoring task progress. In total, the code monitoring task progress accounted for 13.6% of all SSRL codes (M = 9.40, SD = 4.40). In the example below of group 8, student 2 engaged in monitoring task progress by rechecking the rules that they had already incorporated in their story to be sure that whether they address all the rules in their story, see Figure 5.

Figure 5

Example of monitoring task progress

Student 3: *Read aloud the second rule* “We also had already did that” Student 3: *Read aloud the third rule* “Ok, then we need to write down the numbers to indicate the order of the pictures” Student 2: *Noding head*

During online collaborative meetings, students applied some strategies to monitor their progress toward achieving the group's established goals for the task and completing the assignment. A notable strategy of monitoring task progress was observed when the group members tried to recognize what part of the task were completed, and then identifying what remained to be done or what is the next step. However, there were some examples wherein groups did not check back the group’s initial plan, so members would mistakenly assume that they had completed the assigned rule or even they would not recognize a missing rule. For example, in group 1, students did not understand that they would not incorporate the first rule in their story, which was “adding dialogues”.

As a specific example of monitoring task progress in CSCL environment, was evident in two groups. When a student shared the screen within the group, he/she split up the screen

into two parts: one for the rule page and another for the storyboard's page. Then, the group monitored their progress by spontaneously checking the completion of each rule with the different part of the story, which was written under each picture of the storyboard.

Monitoring task performance. Only one group engaged in monitoring task performance (0.58% of all SSRL codes, $M = 0.40$, $SD = 0.84$). As monitoring task performance was observed only in one group (i.e., group 10), it is difficult to determine which conditions are necessary for monitoring task performance to occur. What is more, no specific examples of the code 'monitoring task performance' that could be directly attributed to CSCL were identified in this study. The observed example of monitoring task performance is provided below. During online collaborative meeting of group 5, students discussed to find the best name for their story. They did this by monitoring the quality of their suggestions together, ultimately selecting the most suitable name for their story. In this group, student 1 expressed her idea about the suggested name (see Figure 6).

Figure 6

Example of monitoring task performance

Student 2: "Ok, so the story is about happiness"
Student1: *Nodding head*
Student 2: "How happiness occurred" *Her idea for the name*
Student 1: "Yeah. I like it how well we came up with the name"
Student 2: "Yeah yeah yeah"
Student 1: "When you look at everyday objects, why is it called tree or why is it called laptop. So, this is the story about why feeling happiness is called happiness."
Student 3: *Laughing & nodding head*
Student 2: *Clapping*

Monitoring comprehension. In this study, monitoring comprehension accounted for 1.74% of all SSRL codes ($M = 1.20$, $SD = 1.03$). As an example of monitoring comprehension, which was observed in group 7, after student 1 shared his idea about task

division among themselves for storytelling, he asked other's opinion as well as whether other members understand his mean. As student 2 did not understand student 1's idea, so he explained his opinion again. This example is provided in Figure 7 in more details.

Figure 7

Example of monitoring comprehension

Student 1: "What if we start with one of us, and the second one try to do other pictures to make the fellow of the story?"
Student 1: "What is your opinion about it?"
Student 2: "About which one? sorry"
Student 1: "We make some kinds of story. I start with the first one, for example, I start with the grandpa telling story to children, and then I stop, and you start to use some of the pictures and characters to move on the story based on your way."
Student 3: *Nodding head*
Student 2: "Ok"
Student 1: "Do you know what I mean?"
Student 2: *Nodding head* "yeah"

During online group meeting, other instances of monitoring comprehension were observed. A notable strategy of monitoring comprehension was evident when group members provided feedback to each other. For instance, in group 5, when student 2 suggested altering the genre based on the new pictures that she presented, student 1 requested further explanation about her reasoning. After understanding student 2's idea, student 1 provided her feedback. Moreover, in certain instances like group five, ten and seven, students asked or provided more explanations and justifications to foster collective understand the assignment. In these cases, they focused more on essential elements of the task (e.g., pictures or characters). Additionally, monitoring comprehension was found when group members had more focus on monitoring for finishing the task quickly, rather than conceptual understanding of it. In this example, when a student suggested an idea without providing a reason, others

accepted and modified his/her idea by making changes directly to the task without seeking clarification or offering feedback. This happened in group 8, when group members accepted their ideas regarding the selected genre and pictures for the story, by directly switching ideas to the task without asking input to explain the modification. This occurred because, at the start of the online meeting, student 1 mentioned being in a rush, with only 30 minutes to participate.

As particular examples of monitoring comprehension which stands out specifically in CSCL, were evident in groups one, five, two and nine. After students proposed an idea, they often checked whether others understood the idea. Specifically, in group 9, since students 1 encountered technical issue with her laptop and internet connection. Students in these situations engaged in monitoring comprehension by asking questions like “Can you understand my mean?” or “Did you hear what I say?”. Moreover, during the online collaborative meeting of group 2, there were instances where students 1 and 2 spoke simultaneously. As a result, they could not understand each other’s ideas. This caused student 1 to express confusion by asking, “What? I don’t understand what you say.”

Task perception. In this study, task perception was not frequently used strategy among students in online meetings (4.92% of all SSRL codes, $M = 3.40$, $SD = 4.40$). During the online collaborative meetings, it was observed that once students progressed in the task and they gained more information regarding the topic, they adjusted and expressed their perceptions toward it. Throughout this process, new ideas shared, and diverse perspectives introduced, discussed, and ultimately either incorporated or dismissed. As an instance of task perception, in group 5, student 1 proposed her idea about starting the process by choosing the names for characters, as naming characters was one of the rules. In response, student 2 shared her perception on the task completion and recommended delaying choosing the names, as she

considered it easy part. The Figure 8 shows this conversation between these two students in a clear manner.

Figure 8

Example of task perception

Student 1: “Shall we give them names already then?” Student 2: “Yeah, I see there are 6 or 7 figures that we can choose from, and I think we can start with rough storyline, upon we agree on, and then it would be easier. Because the names are the easiest part, even we can give names at the end” Student 3: “Yeah” *Nodding head*

Totally, what is particularly notable regarding the subcategory of task monitoring (i.e., monitoring task progress, monitoring task performance, monitoring comprehension, and task perception), is that most groups monitor their progress and comprehension during online collaboration while other subcategories of task monitoring were not used often (20.84% of all SSRL codes, $M = 7.49$, $SD = 14.40$). There were seven groups that often monitored the task comprehension and progress, whereas there were three groups that were comparatively less engaged in task monitoring. When high percentage of task monitoring was observed regarding the quantity of occurrence, students frequently monitored their progress and required further discussion for more clarification among the members. They also often checked whether they reached mutual agreement on discussed parts of the story and/or whether they addressed the assigned rules of the story. Typically, the groups achieved these by asking questions, responding to other members’ ideas, requesting further explanations, and expressing agreement or disagreement. However, other example of task monitoring also found when students completely rely on the monitoring by one of the members. In this situation, which found in three groups, when one student assumed the role of leader,

typically, there were almost less discussions or shared task perceptions during the meeting, was observed.

What is specifically can be attributed to the CSCL regarding the code task monitoring, was noted in seven groups. In most groups, almost at the start of online collaborative meeting, students monitored that technical aspects of the assignment and/or the platform used for the assignment to be sure that were functioning correctly. This process of monitoring involved checking for updates, posting a comment in the storyboard's comment box, and verifying that others could see the comment by asking questions such as "Can you see what I'm typing?"

It is important to highlight that there seems to be a significant overlap between task monitoring and constructing shared knowledge. When groups engaged in task monitoring, they worked collaboratively to respond the rules and think about the content of their story as well. Here, task monitoring involved asking questions, providing feedback, or requesting elaboration for further explanation or clarification. Spontaneously, by monitoring the quality of the content and understanding others' ideas in the discussion, it clearly observed that the group engaged in constructing new knowledge among members.

Task evaluation

Evaluating task outcomes. Evaluating task outcomes Across all collaborative online meetings, there was only one situation in which task evaluation was observed (3.18% of all SSRL codes, $M = 2.30$, $SD = 2.20$; see Figure 9). In this example, which occurred in group 5, student 1 asked other members if they agreed to write down their ideas in the comment box.

Figure 9

Example of task evaluation

Student 1: *After she wrote the numbers in the comment boxes of the storyboard*" Do you agree with it?"
Student 3: "Yes"
Student 2: "Yes, I think"
Student 1: "Ok

Cognition

In total, all groups performed shared cognitive strategies within the context of current study (22.57% of all SSRL codes, $M = 15.60$, $SD = 7.06$). In the section bellow, two distinct subcategories of cognition are outlined, along with frequencies and relevant examples which were found through online meetings.

Task cognition

Verifying. Verifying accounted for 15.19% of SSRL codes in total ($M = 10.50$, $SD = 4.77$). This cognitive strategy was applied in all groups. In the provided example below of group 10, students engaged in a discussion about the sequences of events in their story. Student 1 proposed to add numbers in the comment box of the storyboard based on the group agreement. In doing so, he asked his peers to be sure that whether provided information is right (see Figure 12).

Figure 12

Example of verifying

Student 1: "So, we take "I lost my way" as the second picture? As the start of the story that the grandfather tells, right?" *Then he watched others' faces*
Student 3: *Nodding head*
Student 3: *name student 2* "Do you agree?"
Student 2: "Yeah, yeah I was just thinking about it"
Student 3: "Ohhh ok"

In the current sturdy, the most frequent instances of verifying were to ensure the group's readiness to move on to the next rule. This process was observed most often at the end of the discussion about each rule. Also, it is worth mentioning that in two groups, verifying and monitoring task progress had co-occurrence. This was observed when students reviewed and rechecked the sequence of the pictures in their story, by asking questions to ensure that everyone had the same understanding of the story, the discussed rule, and the accuracy of the information provided. For example, in group 6, after student 1 checked the sequence of the pictures by naming them, she promptly asked her fellow members if the information was correct. A particular instance of the code of verifying in CSCL environment was found in group 9. In this example, Student 3's laptop encountered technical issues, and the screen became stocked in the almost middle of the meeting, and she could not see the pictures and the comments, written by another student, in the storyboard. As a result, Student 1 asked Student 2 to explain the storyboard pictures to her. After each explanation, Student 1 sought confirmation from Student 2 to ensure she understood correctly. For example, she asked, "So, is the second picture the grandpa?". Moreover, another notable example of verifying in CSCL, was observed in group 3. In this instance, student 2 noticed a change in the order of pictures of the storyboard, then she asked, "Someone move the stuff's order?". Other particular instances of verifying during online meetings, were evident when group members sought to be sure that they were on the same page with their teammates. Student did this by asking questions like "You should be able to see everything I typed, right?" or "Now, you can see what I am typing? Right?"

Problem-solving strategy. In total, 7.38% of all SSRL codes undertook shared problem-solving strategies ($M = 5.10$, $SD = 3.41$). An instance of a problem-solving strategy is provided below (Figure 13). In this instance of group 8, students monitored their progress by checking the number of pictures that they had already selected for their story. When student 1

became confused by the chosen pictures, she suggested sharing screen for clear understanding of discussed pictures.

Figure 13

Example of problem-solving strategy

Student 3: “Maybe we can do all the ghost pictures, and then we have 1, 2, 3 ghosts, I think”
Student 1: “Can one of you share the screen perhaps? So, it would be easier for us to collaborate or something like that?
Student 3: “Is it allows? I don’t know”
Student 3: “There is no rule about that. I guess it’s fine. There is no policy about that. We should collaborate, so how can we do?”
Student 2: “Ok, should I share my screen?”

Typically, in this study, cognitive strategy was applied when students wanted to understand new ideas that had not been proposed before and when they aimed to solve a problem collaboratively, offered by the online environment. For example, in group 4, students faced challenge at the start of the collaborative meeting on how view the others’ comments in the storyboard spontaneously, as they were not aware of the Padlet feature that saved comments under each picture. After a brief discussion between group members on how to solve this challenge, student 1 offered sharing the screen to address this challenge and make sure everyone could see the different taken steps. In another example, in the same group, student 1 offered to write the story in a Word document for having the entire story on one page, and then she shared the document in the chat for accessing all group members. In addition, during the group meeting of group 2, student 3 could not see the student’s 1 comment in the storyboard. In response, student 1 suggested to refreshing the page to solve this problem. She said, “Try refreshing the Padlet page”, and then she asked, “Can you see it now?”

It is critical to highlight that in this study, when group members collectively addressed the task-related challenge, they metacognitively monitored other members' comments and responses to address the challenge. Here, cognition strategy involved the group member's attempt to share ideas and apply prior knowledge or experience to the group's problem-solving process. Spontaneously, because students were responsible for task monitoring by providing explanation for their peers (i.e., monitoring comprehension and/or motoring task progress), the result was solving the problem that reflected a group response. Thus, cognitive regulation happened simultaneously with metacognitive regulation. Consequently, socially shared regulation occurred within the CSCL setting by answering the task related challenge and monitoring the answer.

Motivation

Task motivation

Stimulating task focus. Stimulating task focus strategy was not frequent in this study (1.74% of all SSRL codes, $M = 1.20$, $SD = 1.23$). This regulation strategy was generally predictable across groups because often occurred after periods of off task talk or silence. In group 10, for instance, after group members specified the pictures of their story, they were very busy to develop a storyline for each picture. Student 2 was talking about the almost final picture, which did not align with the current part that the group was focusing on. Therefore, student 1 motivated student 2 to stay on task and complete the relevant section of the story (see Figure 14).

Figure 14

Example of stimulating task focus

Student 2: “it could be everything that happened in the magic forest or the magic jungle, hhhhmmm, is happening in a different time zone, so we have the telephone. So, at the end of the story, the main character could see some like, yeah, that was a really weird place.”
Student 2: *Continue along with previous idea* “I don’t know it could be also…”
Student 1: “Would you mind to stay back to the telephone is ringing and who is talking on the telephone and what they are going to tell?”
Student 2: “because it could be also completely abstract and fun.” *Continuing made new ideas for the end of the story*
Student 1: “I mean we might be taking it too far then.”
Student 2: *Laughing*
Student 1: *student’s 3 name* “what do you think? Who is on the phone?”

Particularly, as an example of stimulating task focus in an online setting, was evident in group 10. Almost at the start of the meeting, Student 3 was surprised and distracted by the various rules and storyboard’s pictures designed in Padlet page, exclaiming, "Oh my god, such a cool toping, that’s so amazing!” In response, Student 1 encouraged her to focus on the task by saying, "Guys, are we all in the storyboard?”

Praising. In this research study, the code praising accounted for 7.38% of all SSRL codes (M = 5.1, SD = 2.85). This regulation strategy was almost frequently used during online group meetings. The example below that demonstrated by group 8, students discussed about the events in their story based on the pictures. After student 2 shared her idea for the next part of the story, student 1 responded with positive remark to praise her contribution (see, Figure 15).

Figure 15

Example of praising

Student 2: “It’s a magic jungle, so one of these people can be stocked for years, and then other one can find her.”
Student 3: *Laughing* “It’s true”
Student 1: “I like this idea for sure”
Student 2: *Laughing*

In total, during online group meeting, only 9.12% of all SSRL codes, accounted for the subcategory task motivation regulation ($M = 6.30$, $SD = 2.67$). Instances of task motivation were evident when one student encouraged another to avoid off-task conversations, when group members were not concentrating on the specific part of the task at hand, or when one member remained almost silent during the execution of the task. The regulation of task motivation occurred in several conditions. Firstly, in four groups, when students in a group were familiar with each other, indicated by greeting each other by name, off-task talk were more observed, and the percentage of task motivation regulation in these groups were higher than other groups. Secondly, especially after a few minutes had passed of sharing the rule page, task motivation strategies became evident. This situation, found in eight groups, one member often motivating others to stay focused. It was evident that students who had more directive role in the group stimulated task focus. Instances of stimulating task focus included statements like “Guys we need to come up with the title *after the group engaged in an off task talk*” or “Does everybody done with the rules?”. Furthermore, the regulation of praising was observed when students shared their perceptions and positive ideas regarding someone else idea. Several instances of praising were observed such as “It’s good idea”, “I like your idea”, or “It’s nice idea.” Other example of utilization of parsing regulation which specifically stands out in online platform, is evident only in one

group. When a student expressed her idea, another student praised her by using the 'like/tums up' feature of Microsoft Teams.

However, it was also observed that within some groups, when members held different ideas or personal priorities, two distinct patterns of participation emerged. Firstly, certain students attempted to assert their own preferences and persuade others to adopt their ideas for the task. Secondly, when individuals proposed ideas that were subsequently rejected, they often showed less contribution for further discussions. It was evident in seven groups that not all group members actively contributed to the task discussion, which might be called the need for applying the stimulating task focus regulation. This means that one student showed relatively low participation, such as asking questions, providing feedback, or sharing ideas related to the task. As a result, other group members had already made efforts to re-engage this student in the task.

RQ2b; Investigating the Manifestation of SSRL in terms of Group Regulation Strategies in a CSCL setting

Metacognition

Group planning

Coordinating collaboration. In the current study, a low percentage of the groups engage in group planning regulation strategy (3.18% of all SSRL codes, $M = 2.20$, $SD = 1.32$). In group 1, for example, when students agreed to change the numbers below each storyboard's picture, student 1 prompted student 2 to continue the story's narration. Then, based on student's 2 explanation, he changed the numbers under each picture. Through this process students the task was divided (see Figure 10).

Figure 10

Example of group planning

Student 2: “So, 1883 is once upon of time.”
Student 1: “Yeah Yeah”
Student 2: “It was a girl who was looking for happiness”
Student 1: “Exactly, so number 2 would be the girl” *He assigned the numbers under each picture*
Student 1: “Continue *Name student 1*” “based on what you say I’m changing the numbers”
Student 2: “That’s a lot of responsibility” *Laughing”
Student 3: “Laughing”

In total, there were some situations that coordinating collaboration was employed during online collaborative group meetings. Most examples of group planning occurred towards the end of the online meeting, when students focused on addressing the rule 4 of the assignment, which required them to explain the story from the beginning. Students accomplished this by dividing the pictures among themselves to explain their collaborative story. In addition, another instance of group planning, which occurred during the assignment not toward the end, students agreed upon dividing the pictures into three parts, then they aimed on adding an event to the story of their own part based on their preferences. However, an instance of low commitment to group planning was also observed. In this case, which was observed in group 7, students were unresponsive to the conveyed plan regarding task division. This issue arose when student 3 engaged in off-task talk during the execution of the task and failed to understand the part of the task that being discussed. Consequently, the other members repeatedly explain the story from the beginning, but the distracted student kept postponing her contribution.

Moreover, particular examples of utilizing group planning in the context of CSCL, were evident in three groups. Group members engaged in dividing the task related activities,

such as typing different part of the story in the comment box at the same time on the Padlet page. For instance, in Group 10, students 1 and 3 aimed at typing different parts of the story in the comment box of the storyboard's page spontaneously. During this process, they provided brief updates on their typing progress, which involved reading their notes aloud before submitting them.

Group monitoring

Monitoring group performance. In the current study, only one group with 0.14% of all SSRL codes, engaged in group monitoring (M = 0.31, SD = 0.10). As an instance of group monitoring, which occurred in group 10, students were discussed about the events of the story. Student 3 suggested horror genre for the story which can be understood from the events that she shared, but the suggested genre was not compatible with the pictures. In response, after student 2 monitored how well the group is doing as a team, he expressed his idea about the student's 1 suggestion. The Figure 11 illustrates the description of this engagement.

Figure 11

Example of group monitoring

Student 3: "The story is like that he goes out to search for Patsy. He finds it but the ghost is killing the dog because he is thirsty. He drinks his blood, but the main character gives him some colla." Student 2: "Yeah, but then are their bond to the pictures? Only to the pictures that we have?" Student 2: "You know, the way we are doing is perfectly fine, you know" Student 2: "But then, are we supposed to stick to the pictures? And only talk to come up with the story about the pictures?

Since group monitoring occurred only once time, it is challenging to identify the condition for occurrence of this regulation strategy. However, it is important to note that there were several examples of non-verbal expressions of group agreement regarding their performance such as clapping, nodding head, or thumbs-up gesture during online group

meetings. The members of a CSCL teams were often demonstrated non-verbal satisfaction after completing a structured plan to address a rule, indicating that they believed their group had successfully met the requirements. For example, in group 5, when the team came up with the name for their story, and student 1 shared her opinion about the reason behind the selected name, student 2 expressed her happiness of group functioning by clapping.

Behavior

Positive social interactions

Inclusion. In total, only 5.93% of all SSRL codes were analyzed as positive social interactions ($M = 4.10$, $SD = 3.60$). An example of inclusion in this research study, can be found in group 7. In this instance, when students engaged in coordination collaboration, which was dividing the picture for storytelling, student 1 finished his part and then encouraged student 3 to continue. Although student 1 could have selected student 2, he opted for student 3 because she was not paying attention, and she was almost silent during the process (Figure 16).

Figure 16

Example of inclusion

Student 1: “It is your turn *name student 3*”
Student 3: “With the second picture?”
Student 2: “No, we are in the nurse’s ghost picture”
Student 1: *Nodding head”

Across all online group meetings, it can be evident that positive social interaction generally occurred when group members showed respect to each other and when they aimed to support and incorporate one another’s idea to the task. Typically, several patterns of positive interaction behaviors were identified for sustaining on-task behavior. The first pattern involved students engaging in inclusion, by encouraging their fellow group members

to share their ideas and perception that had not been address before. For example, in previously mentioned example, when student 1 asked student 3 to continue the story, she requested to add the new part to the task by her creativity, which had not been addressed before. The second pattern of positive interaction behavior in this study, occurred when students supported their fellow group members by providing feedback and assistance. For example, in one of the groups, a student expressed her idea and was positively reinforced by another student saying, “That's a really good idea; we can proceed with this.” Other examples of inclusion in this study, include “What do you think we should do?”, “Do you guys have any idea?”, or “Do you think how we can do that?”. Another pattern of positive social interaction involves group members gaining attention without offering feedback or incorporating new ideas. Examples of this pattern includes, in group 3, where student 3 was almost silent throughout the process, and despite some efforts of other students to include her in the discussion, she refused to share her opinion, and she said, “I don’t have any comment”. This pattern can be served as a quick reminder to re-engage silent group members.

Interestingly, it was also observed that in a number of groups, when a student was off task during the online meeting, others allowed him/her to remain disengaged and they did not seek his/her input on the task. For instance, there were several situations where one or two students discussed about the rules or events of the story and they failed to re-engage the silent person to the task, so they were continuing the discussion without addressing the off-task person. For example, in group 3, when student 3, who was almost silent during online group meeting, was also offline for a few minutes, and her group members did not notice her absence. These prolonged off-task behaviors likely increased the burden on the active members, as they tended to enhance the quality of their story and address all the rules within a certain timeframe.

Specifically, example of the code inclusion regulation strategy which unique in the context of CSCL, observed in group 5. In this instance, student 3 experienced a brief internet disconnection. Upon his return and announcement of his absence, student 1 responded with, '*name student 3* did you lose something?'.

Discussion

Introduction to the discussion

This study was novel in demonstration of student's engagement in both task regulation strategies and group regulation strategies, by utilizing the theoretical coding framework developed by Hogenkamp et al. (2021) in the context of CSCL. The purpose of this research study was to analyze the extent of student's engagement in SSRL during their participation in an online collaborative learning setting. To achieve this aim, the frequencies of SSRL occurrences were computed. Moreover, in this study, the manifestation of SSRL was also investigated by means of observing instances of student's collaboration and their engagement in SSRL during online group meetings.

Investigating the Extent of Student's Engagement in SSRL in terms of Task Regulation Strategies in a CSCL setting

The result shows that in online collaborative meetings, students were busy by regulating task dynamics. Especially, task planning and monitoring task progress were the most frequently performed activities compared to other task regulation strategies. This is consistent with findings by Hogenkamp et al. (2021) and Haataja et al. (2018) who noted that students more frequently monitor task-related behaviors, as they believe these are more to be directly related to the task, and so these behaviors should be elaborated on more frequently. The higher percentage of task planning and task monitoring in compared to other task regulation was not surprising because for students; to be able to complete the task, they needed to plan the task and monitor their progress carefully (Van der Meijden & Veenman

2005). In the current study, it was evident that task planning marks the direction and structure for collaboration, since the group clearly identifies what needs to be done. During task planning, decisions were made collaboratively rather than by one person directing others. Based on Shukor et al. (2015), this is important for online collaborative learning because effective online collaboration requires coordination before achieving shared goals. Moreover, it was revealed that task regulation strategies play a crucial role in overcoming the inherent challenges posed by the virtual interface (Janssen et al., 2012). The regulation of task cognition was particularly important when group members encountered challenges such as misunderstanding of task-related parts or struggling in finding the right place to type out the different parts of assignment. Sharing the screen or typing on the Word document was done to answer to the lack of face-to-face interaction in the CSCL environment. When the screen was shared all students in the group were able to see the outcomes of the task's part that the group was working on it. This process, led to knowledge sharing among group members.

An interesting finding throug the analysis of SSRL within the CSCL environment was the added responsibility of monitoring, which extends beyond the content of the task itself to include monitoring the technological aspects of its execution. This additional layer of monitoring can be attributed uniquely to the online collaborative setting, where students are not only responsible for regulating the assignemnt but also ensuring that the digital tools and platforms that they rely on are functioning correctly. The frequent inquiries such as "Did you hear what I say?" or "Can you see what I'm typing?" indicated that students are actively engaged in monitoring the technical setup, checking for updates or verifying the visibility of their contributions. This dual focus might add an extra task cognitive burden to the students, as they must divide their attention between the intellectual demands of the task and the operational aspects of the technology. This observation might underscores the importance of providing adequate technical support in online learning environments to help alleviate the

additional load and to ensure that students can focus more on the content and collaborative aspects of their tasks without being hindered by technological issues. This finding was also proven by Hadwin and Oshige (2011) who believed that when students try to regulate their collaborative learning activities collectively, the technology-mediated collaborative learning settings might pose unique challenges for them. Hence, researchers are calling for providing support for technology-mediated collaborative learning environments (Zhang et al., 2021).

Moreover, another notable observation regarding task regulation strategy in the context of CSCL was the high frequency of motivational regulation, such as praising. The need for this type of regulation becomes crucial in online environments because the absence of non-verbal cues, such as body language and facial expressions, can lead to a decrease in group cohesion and individual engagement. Without these cues, students may struggle to feel connected or validated by their peers, which can negatively impact their motivation and focus on the task at hand. To compensate for this, group members likely increased verbal expressions of praise and encouragement to maintain a positive and motivating atmosphere. This is in line with the findings by Volet et al. (2009), who argue that in the absence of non-verbal cues in online environments, the expression of positive emotions through verbal interaction plays a crucial role in motivating students and fostering a higher level SSRL through verbal interaction. Yet, in contrast to the frequent use of motivational regulation, there was a noticeably low percentage of task evaluation occurring during the online collaborative meetings. This discrepancy may also be attributed to the nature of the online collaborative interface. In the CSCL environment, where all task-related parts and comments were visible to students on their electronic devices, the need for verbal task evaluations was likely diminished. Consequently, the evaluation process may have become more implicit, with students relying on the visual feedback provided by the shared workspace rather than engaging in explicit discussions about task completion. This aligns with the findings of Lee

(2014), who noted that members in online collaborative groups often skipped explicit task evaluation because of the transparent nature of the CSCL environment. The interface allowed students to monitor progress in real time, reducing the necessity for formal verbal assessments. In essence, the platform itself may have compensated for what would normally be a more prominent verbal component in face-to-face settings.

The observations in this study indicated that task-rated regulations including planning, monitoring, cognition and motivational engagement did not happen in isolation. Groups that had high percentage of SSRL codes, typically exhibited high ability across all four regulatory processes (i.e., planning, monitoring, cognition and motivational regulations). This is in line with research by Rogat and Linnenbrink-Garcia (2011) who suggested that task regulation strategies often interact dynamically, and they frequently co-occurred and mutually influenced one another. Accordingly, in the current study, it was found that there was considerable overlap between planning and monitoring, which means that these two regulation strategies often happened at the same time. For example, students not only monitored the group's understanding of task directions but also, they monitored the enactment of the group plan. Yet, taking group differences into account regarding the quantity of task regulation strategies, it remains unclear why some groups indicated a high percentage of task regulation strategies in all aspects of task-related regulations, and more specifically, which individual differences might account for these variations (Panadero & Järvelä, 2015). It might be that the nature of CSCL introduces unique challenges such as limited perception and processing of other members' participation when communicating, negotiating, and monitoring responses via a technological interface (Janssen and Bodemer 2013; Lee et al. 2015; Malmberg et al. 2015), which may amplify the impact of individual differences on these variations regarding quantity of task regulation. This finding was also supported by Järvelä et al. (2016). However, the individual differences were likely present in

all groups, so the context of this study cannot explain why different groups show variations in frequency regarding task regulation strategies. Yet, it could be questioned whether the absence of any one of these strategies affects the overall students' collaboration in an online setting. During the coding phase, it was observed that a lack of some skills such as task monitoring led to misunderstandings of task directions and an increase in off-task discussions. In CSCL environments, where students rely heavily on verbal communication, these misunderstandings might be more pronounced and harder to rectify quickly compared to in-person settings. Similarly, when task planning was unclear or used infrequently, group members overlooked essential task directions, which were necessary in order to reach the task to a good end. This was proven by Hogenkamp et al. (2021) who believed that the lack of planning lead to confusion and off-task talk. This is also problematic in CSCL, where the asynchronous nature of communication can cause delays in resolving these oversights, leading to confusion and a decrease in coordination among group members. Hence, collaboration among group members was less coordinated as individual students who acted as leader tried to form the group product. This finding consistent with Shukor et al. (2015) who believed that in lack of planning, metacognition was very unlikely to be shared as collaboration was terminated immediately in CSCL environments. Therefore, these skills—monitoring, clear planning, and effective communication—are not just essential for any collaborative learning environment but are particularly crucial in CSCL settings, where the lack of physical co-presence requires more deliberate and structured regulation to ensure productive collaboration as failure to engage in these shared processes resulted in less time being devoted to the task.

In addition, the importance of some task regulatory skills was not easily determined as these skills were observed rarely or even absent. For instance, since task evaluation emerged only in one situation across all collaborative online meetings, the effect of this regulatory

strategy could not be evident. Additionally, it is worth mentioning that the evaluation of task outcomes in observed situation was superficial, as the group members only briefly discussed whether they agreed to type their ideas in the comment box without explaining their reasons or offering alternative methods. This aligns with findings by Hogenkamp et al. (2021), who believed that task evaluation is a scarce process and students had not evaluated the task outcomes because they may not be aware of their group standards (Winne, 2014). Accordingly, within the category of task monitoring, two subcategories of task performance and task perception were also scarce. All in all, since this study did not examine the students' performance, it is not possible to determine whether the absence of certain SSRL skills negatively impacts the task outcome.

Investigating the Extent of Student's Engagement in SSRL in terms of Group Regulation Strategies in a CSCL setting

In analyzing the data, it was found that the frequency of group regulation strategies with regard to quantity of occurrence (9.26%)., was notably lower than that of task regulation strategies (90.74%). This is consistent with research by Haataja et al. (2018) and Janssen et al. (2012) who suggested that for SSRL, students were found to elicit more task-related regulation strategies as compared to the group-related regulation strategies. Also, not all aspects of group regulation strategies such as instances of negative social interaction, including disrespect and corrective behaviour were not observed in the current study.

Participants in some groups collaboratively arranged the task division and skillfully synthesized different ideas to form a unified and cohesive perspective on the assignment. The ability to engage in task division and build upon various perspectives could be attributed to the participants' metacognition level. Based on Kuhn (2015), students who actively engage in metacognitive processes are adept at connecting with and understanding their peers' thoughts. However, it remains unclear why some groups engage in group planning while others do not.

Yet, it was revealed that when the regulation of group planning was employed, all students in the group had the chance to express their ideas. Specifically, in the context of CSCL wherein lack of face-to-face interaction may hinder the collaboration, group planning might prevent confusion (Lee, 2014). Accordingly, in the current study, it was evident that when each group member clearly understands their responsibility, confusion is minimized, and it became easier to hold individuals accountable for their contributions. This is in the line with Kwon et al. (2014) who believed that for SSRL within CSCL environments, collaboration became more synergistic when groups divided the tasks. They suggested that division of task-related activities allowed students to seek consensus and build on their knowledge in CSCL context (Chen & Tan, 2021). However, the current study revealed that when group planning regulation was not clearly defined, students often relied on one member's ideas and the rest of the group remained almost silent during the execution of the task. This might happen because all group members had not the opportunity to share their opinions or felt responsible for the task.

Taking the low frequency of group regulation strategies into account, the infrequent occurrence of 'group monitoring' might be explained by the nature of CSCL. With focus on online collaboration, students often centered on task completion rather than social interactions (Gyasi & Zheng, 2023). It might be the structure of online collaborative tools can further reinforce this task-oriented focus, leaving little room for verbally expressions of group's satisfaction or dissatisfaction regarding their collaboration. This finding was also proven by Zhang et al. (2021) who believed that in unique environment of CSCL, many students lacked the required regulatory skills for group collaboration such as actively monitor and support group's regulation and interact productively in the group. Moreover, the lack of immediate feedback in online environments can dilute the immediacy and importance of feedback. When group members are not interacting in real-time, the opportunity to

spontaneously express satisfaction with the group's progress may be missed or deemed unnecessary. Similar finding was reported by Hehir et al. (2021). Another possible reason for low percentage of group monitoring can likely be attributed to the friendship of group members, indicated by their use of names when greeting each other. In this research study, there were seven groups that were knew each other. This finding is surprising because a positive group atmosphere is typically seen crucial for effective regulation and collaboration (Janssen et al., 2011). It was observed that when group members were friends, they were more likely to feel comfortable on expressing ideas regarding the task. In a positive climate, trust tends to develop faster among group members, which help members in the group to perform more effectively (Wilson et al., 2006). Familiarity among group members might lead to complacency, where members assume that they are well-doing regarding their collaboration. As a result, they might not feel the need to explicitly monitor or discuss their performance, relying instead on their implicit understanding and mutual trust. This finding corresponds with Rogat & Linnenbrink-Garcia (2011) who suggested that too social activity among group members during collaboration, can negatively impact group performance.

In addition, it is important to highlight that the most notable negative behavior observed in this study involved ignoring a student's request for clarification. According to Webb et al. (2006), when requests for help are initially ignored, this can prevent the further seeking of assistance and is considered as a negative socioemotional response. However, since the coding framework developed by Hogenkamp et al. (2021) do not include ignoring behavior, this specific instance was not categorized as negative social behavior. Hence, as there were no instances of negative behaviors, in this particular category it remains unclear when this regulatory behavior might occur or what are the potential consequences could entail in CSCL settings. Also, it is not possible to include an effective comparison between negative and positive social interactions in this context. However, as stated by Rogat and

Linnenbrink-Garcia (2011), groups characterized by positive socio-emotional interactions tend to have higher quality of monitoring, planning, and behavioral interactions compared to groups with more negative socio-emotional interactions. However, as the performance of the students was not investigated in the current study, the impact of low percentages or lack of SSRL skills regarding group regulation in an online setting on the task outcomes, will remain unclear.

Implications

The findings of the current research have several implications for teachers and developers of online learning platforms. While it was already understood that supporting SSRL in CSCL is crucial (e.g., Järvelä & Hadwin, 2013; Zhang et al., 2021), this study emphasizes the importance of tailoring guidance to promote the four targeted regulatory processes of SSRL—metacognition, cognition, behavior, and motivation—by addressing particular challenges observed in the context of online learning environments. More specifically, the current study revealed that students often struggle with maintaining shared goals, which might due to the asynchronous nature of online discussions. Therefore, educators should implement more structured discussion rules and provide tools or prompts that facilitate ongoing shared monitoring and evaluation during synchronous online sessions. Additionally, the current study highlights the necessity of clearly defining roles within the group to ensure each member understands their unique contribution to the collaborative process, which in turn enhances motivation and accountability. These findings contribute actionable strategies for educators to improve the effectiveness of online collaborative learning by directly addressing the specific barriers identified in this study.

Furthermore, from social constructionist viewpoint, SSRL refers to the group's collective self-regulated learning (Hadwin & Oshige, 2011). Previous research has focused on social-cognitive perspectives and social regulation of group learning (Rogat &

Linnenbrink-Garcia, 2013), and situated learning (Volet et al., 2009). The current study advances the current literature by utilizing a new developed theoretical framework by Hogenkamp et al. (2021) that emphasizes the importance of understanding shared regulation—encompassing shared goals, plans, monitoring, and evaluation—as a cohesive concept, including both task regulation and group regulation. Consequently, when designing online educational content, it is recommended that teachers and researchers emphasize SSRL in both task regulation and group regulation to enhance the effectiveness of their educational content. As a result, students are likely to experience improved collaboration skills, deeper understanding of the material, and increased overall academic performance.

Conclusion

This research study, conducted in an online setting, investigated the extent of students' engagement in SSRL, the manifestation of SSRL, various patterns of SSRL skills, and the possible consequences of some of these skills. It was revealed that SSRL in a CSCL setting was developed and sustained through three phases. The initial phase started with posing a question or suggestion related to the task. This question serves as a starter, encouraging shared task perspectives. Subsequently, members would start by responding directly to the question. Meanwhile, the rest of the group were able to follow where they were because of this meaningful discussion. However, it was also observed that even in the absence of a question or suggestion, initiating a task response was sufficient to start the topic discussion. In the second phase, members responded to the question or suggestion, sharing their answers, and/or applying their prior knowledge or previous experience to the problem solving while metacognitively monitoring each other's responses. According to Kuhn (2015), students who actively engage in metacognitive activities are adapt at understanding and connecting with their peers' ideas. This ability encompasses clearly articulate and substantiate their own perspectives, as well as thoughtfully addressing their peers' views (Molenaar et al., 2011).

The final phase involved achieving mutual agreement by expressing agreement or disagreement with the final answer.

To conclude, findings of this study show that SSRL processes in face-to-face collaborative learning environment (Hogenkamp et al., 2021; Rogat & Linnenbrink-Garcia, 2011) also emerged in CSCL settings. Students were able to regulate cognition, metacognition, motivation and behavior in the group. However, this study proved that in CSCL environments, SSRL is characterized by the need for explicit communication and clear expression of ideas due to the lack of physical presence. Unlike face-to-face settings, where non-verbal cues and immediate feedback might facilitate shared regulation (Lee, 2014), CSCL requires more structured and deliberate interactions to maintain group cohesion and task focus. It might be the concurrent nature of CSCL limits opportunities for spontaneous regulation, making it more challenging for students within the group to co-construct shared regulatory processes. Accordingly, the current study highlights the difficulties in developing SSRL within CSCL, as the overall percentage of SSRL codes was relatively low (27.58%). This aligns with the findings of Järvelä et al. (2014), who noted that students frequently struggle to regulate their learning process. Research by Hogenkamp et al. (2021) also observed the same phenomenon. Järvelä et al. (2016) also believed that socially shared regulations do not happen spontaneously, although the occurrence of SSRL in CSCL is significant because the nature of CSCL context restricted the group's collective regulation and may jeopardize member's engagement (Lee, 2014). This research study highlights the necessity of structured guidance or support in CSCL to compensate the challenges such as technological challenges that students encountered during the online meetings. In compared to face-to-face settings, where SSRL may occur more naturally, the online context requires explicit adaptive support mechanisms to better facilitate SSRL. This is crucial to ensure that students can effectively engage in SSRL, thereby enhancing the success of online

collaborative learning. Similarly, Azevedo & Hadwin (2005) and Järvelä et al. (2016) concluded past research findings that without guidance, group members in CSCL would fail to effectively regulate their learning. More specifically, the current study proved that through student's collaboration, task planning and group planning were two critical skills for ensuring a structured group working. Therefore, this study emphasized that for the emergence of SSRL, both task regulation and group regulation should be kept in mind. However, despite the importance of these two regulatory strategies, these skills did not always emerge in CSCL. These vital regulatory processes were often missing or occurred in the form of other regulation, when one group member directed the plans or goals for the task to the rest of the group. Therefore, supporting and guiding the development of SSRL should focus particularly on enhancing task planning and group planning skills. All in all, SSRL is a crucial, yet scarce process that should be carefully addressed in educational settings to mitigate unstructured collaborative learning among students.

Limitations and future direction

The present study has two limitations that should be taken into consideration. The first limitation is the small sample size. The data for this study was collected from a small sample of obtain a more reliable and detailed understanding of the regulation strategies used by students when working on a complex but open task in a CSCL environment. Also, a larger sample may help to link the specific regulation strategies with successful task performance.

Furthermore, this study observed significant differences in the frequency of SSRL occurrences between groups. Although the reasons for these differences were not identified in the context of current study, it was noted that some students proposed SSRL strategies that were not taken up by their group members. Similar findings were reported by Rogat and Linnenbrink-Garcia (2011), who observed the same phenomenon. This suggests that it may be valuable to investigate whether, how and which individual differences contribute to these

variations. Understanding these factors could provide better insights into what is necessary for occurrence of effective SSRL in CSCL environments.

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