


Paths of Socially Shared Regulation of Learning Students in Online Mediated Activities

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Abstract: This article aims to analyze the regulation of learning as a practice shared interactively among basic education students when they use digital technologies as a mediating mechanism for learning activities. Labor, material and sensory aspects were explored in a teaching-learning context. Data were collected from 17 elementary and high school students. The analyses allowed us to identify perceptions about the possibility of sharing mutual help experiences and strategies for regulating learning. Evidence of the regulation of learning as a practice distributed between physical and digital spaces and subjects was identified. This influences individual and group attitudes and student engagement.

Keywords: Socially Shared Regulation of Learning. Students. Engagement. E-Learning.

Percursos de Regulação Socialmente Compartilhada da Aprendizagem de Estudantes em Atividades Mediada Online

Resumo: Este artigo objetiva analisar a regulação da aprendizagem como uma prática compartilhada interativamente entre estudantes da educação básica quando utilizam tecnologias digitais como mecanismo mediador de atividades de aprendizagem. Foram explorados os aspectos laborais, materiais e sensoriais em um contexto de ensino-aprendizagem. Foram coletados dados de 17 estudantes do Ensino Fundamental II e Médio. As análises permitiram identificar percepções sobre a possibilidade de compartilharem experiências de ajuda mútuas e estratégias para regulação da aprendizagem. Identificaram-se indícios da regulação da aprendizagem como prática distribuída entre espaços físicos e digitais e os sujeitos. Isto influencia as atitudes individuais e de grupos e o engajamento dos estudantes.

Palavras-chave: Regulação Socialmente Compartilhada da Aprendizagem. Estudantes. Engajamento. Aprendizado on-line.

1. Introduction

The practice of learning regulation is a crucial aspect of educational settings where physical and spatial distance between students and teachers is present and/or necessary (Salas-Pilco; Yang; Zhang, 2022). Efforts to maintain this practice may involve regulating various dimensions, such as cognition, emotion, motivation, and behavior, which can be beneficial for both individual and group learning (Zimmerman, 2000). Developing these skills can be challenging but is essential to enhancing student engagement and improving competencies such as creativity, cooperation, and empathy, which are important for future educational and professional scenarios.

In shared interactive activities, students are encouraged to create, recreate, and share their practices, thereby broadening their individual actions. Group work serves as an example of situations that can offer opportunities for the development of competencies through collaborative interactions. In this context, Socially Shared Regulation of Learning (SSRL) emerges as a mental, metacognitive, and adaptive process that involves negotiation and collaborative adjustment among individuals (Isohäätä; Järvenoja; Järvelä, 2017). In this process, students must work cooperatively

to achieve common goals that would be difficult to reach individually. SSRL occurs as a collective phenomenon through which students interactively adjust and negotiate conditions and achievements based on their cognitive, behavioral, motivational, and emotional skills (Järvelä; Malmberg; Koivuniemi, 2016) (Järvelä et al., 2016).

Previous studies have focused on characterizing learning regulation linked to feelings of difficulty (Hurme; Merenluoto; Järvelä, 2009), regulatory processes (Kwon; Liu; Johnson, 2014) (Järvelä; Hadwin, 2013), and through video-based observations (Panadero; Järvelä, 2015). However, it is essential to explore the dynamics of interaction and the ongoing relationship with manifestations of SSRL distributed within both physically and digitally shared contexts. In the study by Pereira *et al.* (2021), different interaction patterns among students in a virtual environment were observed, ranging from those who interact more frequently to those who engage sporadically or rarely. Promoting collective action is crucial, as it becomes possible by complementing the skills of individuals and the group (Hadwin; Oshige, 2011). Furthermore, regulation is not only influenced by students' experiences and beliefs but also remains a transient process that requires collaboration to build a shared vision of cognitive, behavioral, and motivational processes (Hadwin; Järvelä; Miller, 2018). In the study by Iiskala *et al.* (2015), communication among students during asynchronous online interactions was analyzed, with a focus on social metacognitive sharing. The authors demonstrated that while students in a group exhibited socially shared behavior, their roles were slightly different. Additionally, some students' contributions elicited more responses and activated greater levels of interaction. Significant relationships exist between students' active participation, their interactions, and the effectiveness of socially shared regulation of learning (Isohäätä; Järvenoja; Järvelä, 2017).

In this context, this article aims to explore the labor, material, and sensory aspects in the search for evidence of SSRL, guided by the following questions: “*How does the activity of socially shared regulation of learning differ from individual practices for student engagement?*” and “*How does socially shared regulation of learning emerge and correlate with interactions distributed across contexts of space and individuals?*” In seeking answers to these questions, it was essential to consider that digital technologies currently provide interactive resources that engage students and enable different strategies for learning regulation. The study advances the field by demonstrating learning regulation as an interactive and distributed practice across physical and digital spaces, mediated by technologies, fostering engagement and collaborative strategies among primary and secondary education students. The findings have potential applications in Intelligent Tutoring Systems (ITS), capable of supporting human tutors and students in collaborative learning regulation journeys.

2. Method

Considering that situated paradigms are appropriate for analyzing learning regulation distributed across space and individuals requires a deeper understanding of the object of study, which cannot be achieved through passive observation alone. Therefore, ethnographic approaches were employed, as they enable the collection of data to understand human practices within a sociocultural context (Horst; Hjorth; Tacchi, 2012) (Pink *et al.*, 2015). Figure 1 presents the process and steps flow in conducting the study.

Reenactment and case examples are utilized for data collection through participatory methods, employing semi-structured roadmaps. Data analysis involves the reenactment of events and the systematic collection of records, from which case examples are derived. For conducting and analyzing responses, data collection is carried out through interviews with individuals, guided by calibrated roadmaps to ensure

consistency in the process. During data analysis, interview responses are transcribed and analyzed inductively, with an emphasis on the content and context of the responses.

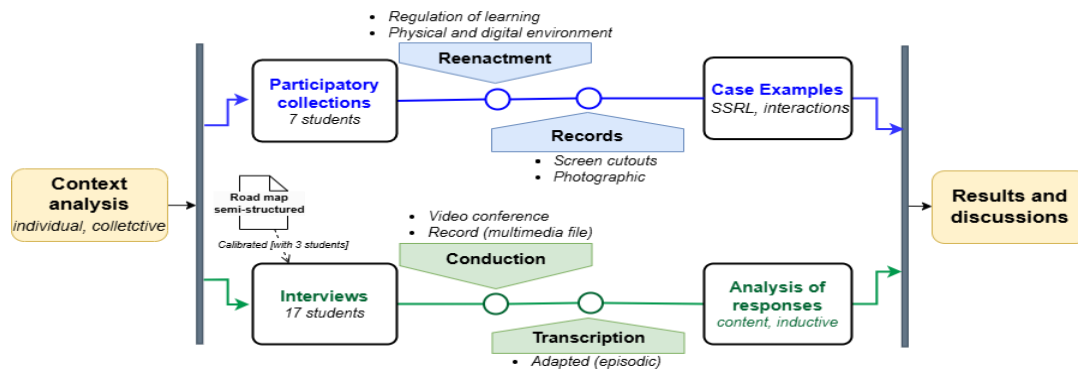


Figure 1 - Flow of procedures and techniques for conducting the study. Source: the authors (2023)

Qualitative approaches were utilized, including interviews and participatory collection of individual and collective practices, to understand how learning regulation occurs, both from the student's perspective and within physical and digital spaces.

2.1. Context and participants

The participants in this study were students from Basic Education, specifically Upper Elementary Education (*Ensino Fundamental - EF*) and High School (*Ensino Médio - EM*), who engaged in a virtual learning environment during online and hybrid learning activities at a federal public institution located in the metropolitan area of Recife, Pernambuco, Brazil. Based on voluntary selection and participation, the students followed activity schedules set by the educational institution and developed practices similar to distance learning and homeschooling (which emphasize learning at home with the support of family members and those they live with). The students' performance level at the institution is considered good (achieving percentages of students with adequate learning, according to QEdU - School Census 2021: 9th grade Upper Elementary with 77% in Portuguese and 82% in Mathematics; 3rd grade High School with 87% in Portuguese and 67% in Mathematics) in knowledge indicators of the Basic Education Development Index (IDEB). The main interactions were mediated by the Social Learning Platform - Redu.Digital, which included the integration of activities, digital educational resources, and didactic-pedagogical materials of the subjects (Reis; Gomes; De Souza, 2014).

The interview sample consisted of 17 students, eight from Upper Elementary Education (♀ = 3; ♂ = 5) and nine from High School (♀ = 6; ♂ = 3), with no other gender reported. These students were voluntarily invited from different classes to ensure a variation of curricular components, tutors, and teachers with whom they interacted, as well as broader pedagogical practices without inducement during the interview process. The interviews were coded sequentially, serving as the basis for subsequent analyses. Among the interviewees, learning pathways toward self-regulation (Falloon, 2013; Iatrellis; Kameas; Fitsilis, 2019; Ramirez-Arellano, 2019) were reenacted with seven students (Upper Elementary: ♀ = 1; ♂ = 2; High School: ♀ = 3; ♂ = 1).

2.2. Data analysis

The technique followed the approach defined by Jordan and Henderson (1995) for interaction analysis, supported by the steps (organization, coding, and categorization) of content analysis as defined by Bardin (1977). However, it was expanded to include descriptive examples of cases aligned with the study's inquiries. The interviews were conducted via online videoconferencing, and multimedia files (audio and video) were

collected. The responses were transcribed and analyzed. The standard practice was to record initial impressions immediately after each interview and begin the transcription process while the researcher still remembered the situations. Reenactments with SSRL manifestations were analyzed based on excerpts that served as starting points for a model of how cognitive goals emerge and present themselves (recalling, rethinking, reflecting on activities), metacognitive experiences (the materialization and meaning of objects for practice), cognitive actions (mental exercises and reflections), metacognitive knowledge (prior knowledge), and, in addition to that, the temporality (transversality and deadlines) of the development of practices surrounding shared regulation to monitor the student's learning process. Finally, the investigation was presented with a descriptive analysis of examples obtained from the group of students.

4. Results and Discussions

When analyzing the context of student interaction, it was relevant to consider that shared regulation is a distributed process based on the collective perception of situated challenges. Therefore, we aimed to observe how interactive exchanges are shared within the context of space and individuals.

4.1. Learning Pathways in SSRL and Individual Practices

In seeking to understand how the activity of SSRL differs from individual practices in student engagement, we analyzed the accounts. Students described their individual practices for regulating learning. We aimed to identify the cognitive and constructive skills of the individual, including effectiveness, metacognition, goal setting, and achievement (Hadwin *et al.*, 2018). The strategic contingencies of experiences in online-mediated activities, the monitoring, and the (re)adjustments of individual behavior and motivation, or the absence of these cognitive processes, were also considered. The accounts suggest a relationship between these processes, individual regulation, institutional planning, and outcomes achieved: A♀01EM: *"I couldn't keep up with the classes well at the beginning [...]. I hadn't done anything. Then I realized it was going to last much longer. I started to accumulate, I couldn't complete everything I had to do. It kept piling up, and I got stressed; it wasn't very good at all."* A♀02EM: *"I separated the subjects for each day of the week, not counting Saturday and Sunday. I divided the subjects for each day and studied. I watched the classes with the teachers. I did the activities with deadlines and submitted them."* A♂17EF: *"I didn't organize myself with a schedule or anything like that, I just looked and tried to organize myself mentally, at least. I managed most of it because, sometimes, there were schedule conflicts, but that didn't happen often; it was just a few times."* A♂15EF: *"I woke up at 7:00 in the morning, did all the activities scheduled for the day, then I took a separate subject, studied it, and then moved on to it. Evaluations, whether they were graded or assignments, each day was a different subject, but I always started with the day's activities to submit the next day, etc., and I organized myself like this the whole year."*

For learning regulation to occur, students referred to the context, including the physical space and location of their school activities, as being metaphysically related to the behavior involved in developing individual practices: A♀02EM: *"And depending on the time and the teacher, it ends up taking a little longer. And I also think that in face-to-face classes, I was a little more committed because I put in more effort in class since there was more pressure, and in remote classes, I ended up procrastinating a little more when it came to studying. Sometimes, I didn't study in advance for the exams, which hurt me a bit."* A♀11EM: *"And in online classes, you could choose when you did things; sometimes, you watched the class while eating something, without worrying about the teacher telling you to put your breakfast away. It's more about that. It's more about the freedom we had that unfortunately got in the way of our studies a bit."* A♀01EM: *"I didn't organize myself very well, and if a message popped up in the group saying — Hey, such a class has started. I would just click on the link and join the class."*

The main goal of regulation is to adapt personally in favor of both dependency and autonomy in the learning process. This requires students to have the ability to exercise both transversal and temporal control over their practices and activities individually, even if these actions are cognitively driven: A♀07EM: *"I managed to do well this year. But I studied at the last minute, and it was still enough to do well. I couldn't stick to any schedule for a while. In these last few months, I gradually fell out of the habit. At the very beginning, I was able to keep up with my studies,*

but later on, I lost the rhythm.”. A♀02EM: “It really depended on the day when the activity was due, for example, if I started studying on Monday and the activity was due on Wednesday. Even if I didn’t have to study that subject on Monday, I would already start working on it. I would watch the class and start the activity because I don’t like doing things at the last minute, otherwise, I get stressed out.”.

In these cases, external elements present themselves as necessary tools for mediating social regulation among students, who improvise personal plans: A♀03EM: “I used to use the calendar. At the beginning, for the first two or three months, they created a schedule indicating the time, day, subject, and which material to post. It was a study schedule that we could print out. They made it available, and I was honestly much more organized at first. I would put everything on my own weekly and monthly schedule, placing everything there according to my time slots. After that, when they switched to using Google Calendar, posting links for us, everything would appear for the month, and the next month too. I also started using my Google Calendar and would write things down in my Weekly Planner. I’d wake up in the morning, study something in the afternoon, but mostly studied at night, which often meant missing a live class or not being able to clear up doubts at a convenient time. But that’s how I did it. I prefer studying at night. In general, I based my organization on the teachers’ posts and the Planner that the school provided.”. A♂15EF: “The routine with the Redu system implemented by the school [[school name]] was a bit more flexible. Some teachers recorded lessons or posted content as slides, putting them on the Redu platform, which we could view anytime. Activities were assigned with deadlines of at least a week, so it was quite flexible. I studied the content in the afternoon when there were no live classes in the morning with some teachers on YouTube. So, when it wasn’t live, we could choose a more convenient time to do the activity or make a summary of the lesson.”.

In contrast to individual practices, those carried out collaboratively reveal a dependency on the collective effort to construct the learning process. When transitioning from the collective to the individual and vice versa, students expressed: A♀01EM: “I struggled because before, we had a set schedule. The school dictated what we had to do in the morning, and in the afternoon we were left to ourselves, just to do homework or study a bit. But now, I was fully responsible for managing my own schedule. It was hard to keep studying in the morning.”.

To achieve shared outcomes, students need to adapt to collaborative interactions and deal with conflicts that highlight opportunities to externalize individual practices, emphasizing the importance of communication with their peers: A♂05EF: “[...] some people are hard to interact with. My classmates say I’m too strict, but sometimes it’s just that some people don’t want to contribute and end up slacking off. I keep telling them to help out, right?! Because there are times when you can’t do everything alone, and sometimes they just don’t want to help. I don’t like that very much. When it came to researching, talking to people to organize parts of the project was tough—it made things more complicated rather than helpful. Sometimes that really frustrates me. That’s pretty much it.”.

In this case, there is an observable interdependence and a need for collaboration in the collective construction of knowledge among group members. The context of group work facilitates the sharing, monitoring, and evaluation of the appropriateness of practices carried out both individually and collectively. Throughout the study, it is noted that interaction data at the group level, such as discussions and the mutual adaptation of individual objectives based on others’ perceptions, can be highlighted in the students’ reports: A♀07EM: “There were very few interactions, but I found it good [...] with other colleagues, I had more ease in asking questions, I could ask about some issues, and we would solve them right away. [...] during the video call, people would be conversing; there was one room just for them. That was the greatest interaction”. A♂15EF: “I think this is not something the school designed, but something I did a lot to learn and interact: it was video calls with my colleagues to do activities together, to see what was wrong and what was right. I found that cool”. A♂10EM: “[...] there was one teacher who had contact with more than one student, but whenever she had to give any announcement or was about to release an exam, she would talk to one person, who would then relay it to the year group. That was also a very interesting contact, or the teacher would always post in the group, as there was a group with all the students and all the teachers per classroom. In this group, the teachers would consistently remind and notify students who had not submitted their work, etc. This greatly helped in recognizing not only who truly cared but also in remembering things, as there was no other form of notification; thus, sometimes, if you didn’t carefully check all the folders, you could miss something. Their continuous postings helped a lot in not forgetting anything”.

In this regard, we can infer that Shared Self-Regulated Learning (SSRL) is inseparable from student interactions with other students, with tutors and teachers, and with the surrounding context, spaces, and external artifacts. Shared regulation differs from individual practices in that it involves interaction among students to collaboratively solve problems, with division of tasks and constant negotiation to construct shared meanings. It entails the mediation of various instruments, creatively adapted by the participants, to carry out their essential activities.

4.2. Origins of Shared Socially Regulated Learning and Correlation with Distributed Interactions in the Context of Space and Subjects

The regulation of learning emerges from distributed interactions within the context of space and subjects. The cross-sectional relationship between the moment when the tutor-teacher provides activities and how this affects students has provided clues for considering the distribution and role of space, subjects, and digital technologies. To illustrate the results, we present examples with details.

4.2.1. Example of SSRL

Shared regulation of learning can begin even before the tutor-teacher introduces activities in the virtual environment. However, when it does occur, participants utilize the virtual environment to mediate interactions regarding the proposed activity. Figure 2 illustrates an example of these interactions. Initially, it is evident from the interactions that students engage with the activity through the posting environment, both for prior interactions and those following the completion of the activity. However, this information is insufficient for us to understand what they do during the interval of activity execution. In other instances, we observe that students interact to form groups, even when the practices do not explicitly require group formation. Indeed, there are exceptions where this dynamic does not occur. Nevertheless, moments were noted, through the Redu.Digital environment itself, where students form groups. Figure 3 illustrates the formation of groups for carrying out activities.

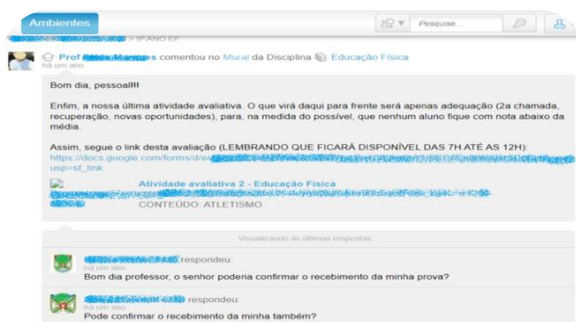


Figure 2 - Posting of Activity and Process of Prior Interaction. Source: the authors (2023)

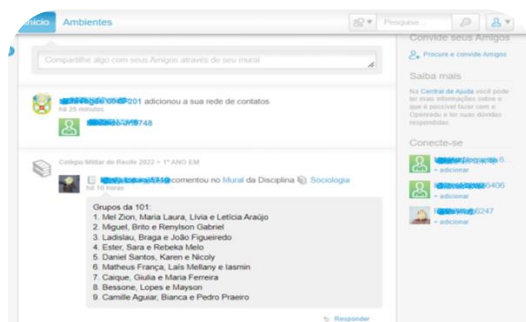


Figure 3 - Snapshot of Group Formation for Activity Execution. Source: the authors (2023)

Shared Socially Regulated Learning (SSRL) can be initiated from the understanding of the progression of stages necessary for carrying out activities. However, it was noted that these stages occur in various contexts, both in physical and digital spaces. The manifestations of SSRL are related to interactions in environments external to the Redu environment (Figure 4). In this example, students replicate the activity provided in Redu and incorporate it into the platform (<https://monday.com>), which allows users to create, organize, and monitor the execution and submission of collaborative activities, thereby establishing a continuous workflow.

Students' reports suggest that this practice aims to facilitate the temporal monitoring of activity completion. When questioned about the use of the external platform to Redu, students reported: A^{06EM}: "It's very good because the [Monday platform] is really helpful; sometimes I was in a hurry and didn't even log into Redu to search for things. I would just come here, and it already had exactly what I needed to do; you would enter here, and it even had the link to the activity, so I could follow along."

In this platform (Figure 5), students also distribute the execution of activities among team members and collectively assign specific tasks to each member. Presents a list of activities assigned to respective group members, along with delivery dates and stages of completion (using conditional colors: green for completed; pink for attention; yellow for in progress; red for late; blue for under review; gray for not started).

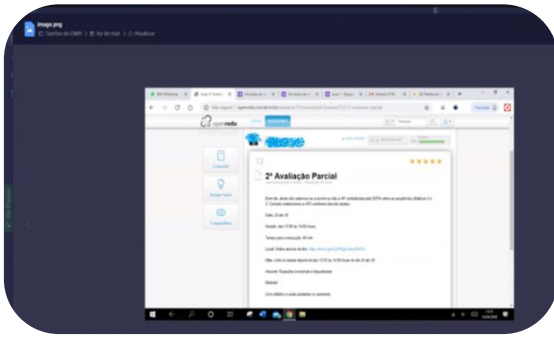


Figure 4 - Snapshot of the Activity Replicated in a Digital Environment External to Redu. Source: the authors (2023)

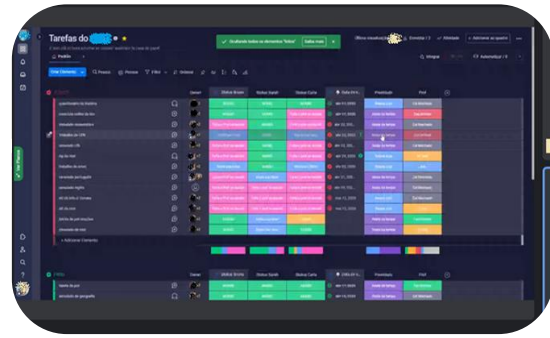


Figure 5 - Snapshot of Activity Distribution for Group Members on the Monday Platform. Source: the authors (2023)

In this case, when asked about the possibility of sharing learning regulation with colleagues, it is evident that this practice is already present and recurring: A♂06EM: “The people who were on the Monday platform were my friends, right!? They are my friends, but we had to be in the same class. We were the people from our group and also my friends. We would post things, and more things, and then we would help each other, you know!? It was like, we needed to finish this activity by tomorrow, so we would study together to get it done.”.

These manifestations of SSRL are also distributed across other platforms. Figure 6 shows the distribution of activities on the platform (<https://trello.com>), which allows for the management of activities and projects either individually or as a team.

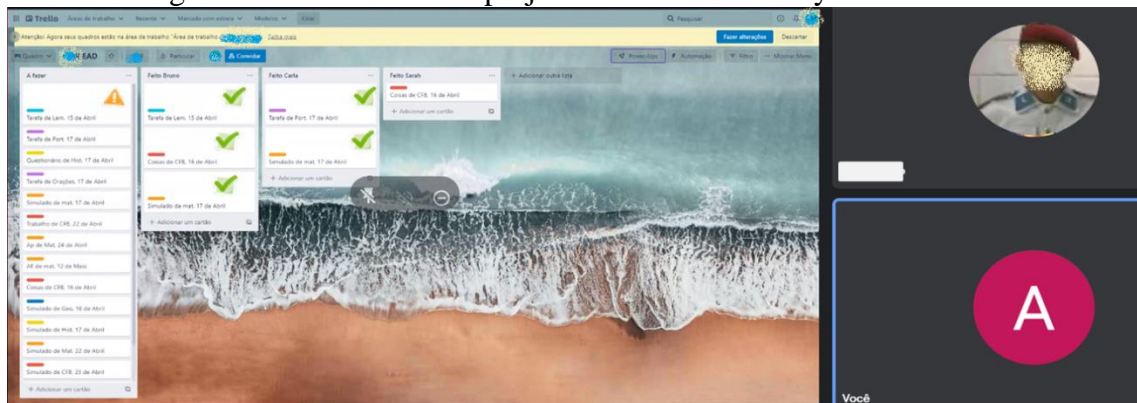


Figure 6 - Snapshot of Activity Distribution on the Trello Platform. Source: the authors (2023)

We can understand that platforms connect students, even when they are physically distant, and can be viewed as strategies to overcome the challenges of tracking the learning process. The reports indicate that managing activities can be difficult: A♂05EF: “It’s somewhat difficult to deal with on a daily basis because, like it or not, I can’t fully control my activities over the years. But, for example, when I try to follow a routine, it becomes a very pleasant experience, but sometimes it doesn’t. I don’t know much. It’s hard; it’s complicated to manage when there are a lot of things to do and many demands, you know? And one thing that’s also challenging is time organization; I always have outside commitments and activities, so it’s tough.”.

Students perceive that digital resources are relevant for organizing and recording the stages of the cognitive process, helping them monitor the completion of activities. This perception emerges when asked about digital resources for regulating learning: A♀04EF: “I think they are essential and indispensable, right!? For example, I use a planner to remind me of the things I have to do. Sometimes I send messages to someone so we can remind each other, sometimes to my friend [friend’s name].”.

In this process, physical resources [in addition to digital ones] are also part of the manifestations of SSRL. Figure 7 shows the posting of schedules and reminders on a bulletin board in the context of the student's home learning environment.

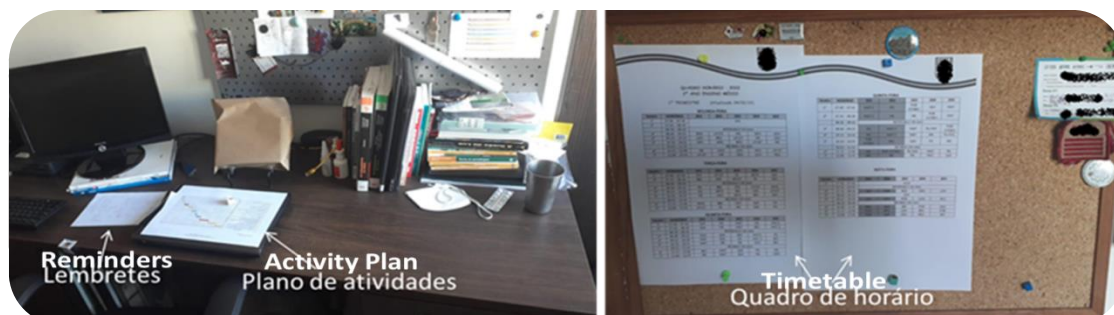


Figure 7 - Learning Space (left) and Schedule Board - Timetable (right) in the Student's Residence.
Source: the authors (2023)

In this type of manifestation, it is evident that, despite being individual: A06EM: *“This is where I stick things I need to do as well, but it takes a lot more work, and when I go to school, I can't tell what's on the board. I don't like it very much. I prefer the digital format; these are more personal things for me that I use to remember, and there are even some health-related items here, like exams.”*

These occurrences revolve around the regulation of learning itself; however, they can be understood as distributed within the context of the space as a working environment for learning activities, which has effects on socially shared regulation. In this sense, while individual practices focus on the understanding of problems in isolation, shared practices emerge from interaction among subjects in a common space, such as a classroom or virtual environment.

5. Considerations

In the study, it was possible to identify that the practice of learning regulation can be influenced in such a way as to lead to distributed actions within the context of space and subjects. However, it is important to understand that movement around Shared Socially Regulated Learning (SSRL) cannot occur impulsively to the extent that it compromises the sequence of actions that provide adequate responses for the execution of the activity. Similarly, it cannot occur in an inert manner, so that temporality does not hinder the completion of the activity within the deadline. It is necessary to seek a tool to mediate these movements, allowing the activity to be carried out with the expected quality and within the designated time. Thus, the virtual environment, to adequately serve as a mediation tool for social regulation, should possess functionalities related to time management for both individual and collective activities.

Identifying this balance requires a prior analysis of the necessary competencies for carrying out the activity, the level of difficulty required, the time available for individual or group execution, and the deadline for the activity. The examples of SSRL highlighted contingencies involving the availability of the activity, the mobilization for execution, the determination of whether it is individual or collective, the cognitive exercise for execution, the analysis of temporality and difficulty level, the detailing of stages for execution, the realization of these stages, temporal and material adjustments, and repetitions of actions. Such strategies may have implications for the design of intelligent systems that cooperate with human tutors to facilitate the monitoring of socially shared learning regulation and participation to chart more effective and successful learning pathways in the teaching-learning process.

5.1. Limitations

As a limitation of the research, we understand that the examples presented are contextually situated representations and do not exhaustively incorporate all possible contingencies that could be raised to analyze shared learning regulation, nor do they emerge and present themselves in a distributed manner within the context of space and

subjects. Furthermore, emotional, cultural, and cognitive factors, which can significantly impact the regulation of shared learning, can be more thoroughly explored in future research. These dimensions are important areas for deepening the understanding of the phenomenon.

5.2. Future Possibilities

A crucial point to be explored relates to the engagement indicators necessary to determine whether the basic principles for the execution of the activity are sufficiently robust for action sequences to occur within the deadline. In the planning and aggregation of efforts to achieve the objectives, approaches involving intelligent agents (Intelligent Tutoring Systems, Recommendation Systems) may be integrated, similar to what was proposed by Pereira, Gomes, and Primo (2023), to mitigate the progress of activities on virtual platforms and provide different incentives to support interactions. Also, for example, in the context of interdisciplinary interactions with multimodal datasets, that involves different physical and digital spaces (Li *et al.*, 2024).

Compliance with Ethical Standards

Conflicts of Interest: There are no potential conflicts of interest in this study.

Research Involving Human Participants: We confirm adherence to moral and ethical principles and compliance with Law No. 13,709/2018 (Brazil), which pertains to data protection.

Consent: Participation occurred voluntarily, duly granted by terms set forth by the institution, tutors-teachers, students, or guardians.

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