

COLLABORATIVE MATHEMATICAL PROBLEM-SOLVING WITH CHILDREN: AN ILLUSTRATION OF SHARED AND SELF-REGULATION IN INITIAL TEACHER TRAINING

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Abstract

This presentation aims to examine the perceptions of kindergarten and primary student teachers regarding shared regulation and its influence on nurturing these skills in children, namely, when solving mathematical problems. We will focus on the first phase of shared regulation, the “preview of the formative process”. This study involved five students pursuing a master’s degree in preschool education and primary teaching, along with the respective groups of children they worked with in internship contexts. Given the qualitative nature of this exploratory study, which involved different methods and techniques – focus groups and training narratives -, data analysis is descriptive and interpretive. The results indicate that students identify facilitating aspects in the shared regulation of tasks, with group support playing a relevant role. They also consider that the kindergarten or the primary teacher can intervene, having an active role in the promotion of these competencies, insofar as they can create conditions for children to learn to solve mathematical problems together.

Keywords: *Shared regulation, self-regulated learning, training narratives, solving mathematical problems, initial training of kindergarten and primary teachers.*

1. Introduction

In these unpredictable times of rapid societal and economic change, pedagogical innovation is crucial—not as an end, but to enhance learning. Adopting educational approaches that engage learners and develop competences such as information-seeking, knowledge appropriation, and problem-solving is essential. Shared regulation is vital in collaborative learning, enabling learners to develop self-regulatory competences through interaction. Education systems should emphasize these skills with intentional curriculum changes, new teaching models, and innovative pedagogical practices. In math, shared regulation fosters interaction and collaboration, enhancing understanding of concepts and encouraging critical thinking and collective knowledge construction. Involving future teachers in instructional cycles is challenging but necessary. To help learners use their resources effectively, future teachers must learn strategically, incorporating self-regulation and shared regulation principles into their training (Veiga Simão & Frison, 2013). Deepening our understanding of these topics can enhance future teachers’ ability to promote learners’ self-regulatory processes, both during their initial training and in their subsequent teaching practice.

2. Mathematical problem solving, self-regulation of learning and shared regulation in a collaborative context in initial training

According to authors Järvelä and Hadwin (2013), regulating learning is the most important competence in collaborative learning, because working together means co-constructing representations of shared tasks, setting shared goals and devising shared strategies. It also means having to regulate learning by monitoring shared metacognition, such as by controlling motivation, cognition and behaviour. Shared regulation then refers to the collective processes that occur when individuals interact and collaborate with each other to achieve a common goal. For this reason, one of the main characteristics of shared regulation identified in the literature refers to how it occurs in collaborative work. Thus, what stands out most in the way groups work is the articulation between cognitive and metacognitive regulation strategies (planning), motivational efforts and the group’s emotional regulation (Panadero, Klug, & Järvelä, 2015). On the other hand, these strategies and efforts are regulated together so that the goal of collaborative learning is

fulfilled, and the principle of collaborative work is to provide a social context in which new knowledge can be created.

The characteristics inherent in collaborative work will allow members to develop not only their self-regulation skills through interaction and mutual support within the group, but also to help with what they bring to the group, thus developing collectively regulated learning. Sharing ideas and accepting others as professionals leads to new experiences that teachers might not have had access to on their own and closed off in their own universe (Cadório & Veiga Simão, 2013).

Regarding the regulation of collaborative learning, when members work in groups, at least three types of learning regulation come into play. Thus, for collaborative learning to be successful, each person needs to be responsible for regulating their own learning (i.e. self-regulation of learning), each person needs to support their colleagues so that they can successfully regulate their learning (i.e. co-regulation of learning) and each person needs to support their colleagues so that they can successfully regulate their learning (i.e. co-regulation of learning) and, finally, to achieve success in collaborative work, the group together regulates learning processes in a synchronized and productive way, sharing representations and establishing a common learning goal (i.e. shared regulation of learning) (Jeong & Hmelo-Silver, 2016). Since collaborative work appears to be a favourable context for the development of shared regulation of learning, there is an urgent need to explore it further in teacher training, particularly in the teaching and learning of mathematics in the early years. Mathematical problem solving based on self-regulation and shared regulation has emerged as a powerful teaching and learning tool for both learners and teachers. This approach encourages learners to become actively involved in problem solving, while the teacher acts as a facilitator and guide in the process. During shared regulation, learners are encouraged to express their ideas, raise questions, and collaborate with their colleagues, promoting the collective construction of knowledge.

This methodology puts learners at the centre of the teaching and learning process, allowing them to develop competences, including transversal mathematical skills in line with the new essential learning in mathematics, critical thinking, problem-solving and mathematical communication (Canavarro et al., 2021). By sharing resolutions with each other, learners analyse different approaches/strategies, discuss their options, and reflect on the different processes used. In addition, self-regulation and shared regulation encourage metacognition, i.e., learners' ability to monitor and evaluate the way they think, identify their difficulties, and implement self-regulation strategies to overcome them.

3. Methodology

3.1. Type and relevance of the study

This exploratory study of a qualitative nature with descriptive and interpretative data analysis is part of initial teacher training in which future teachers, in the context of supervised teaching practices, are challenged to co-construct strategies to achieve a common and shared goal, where in the process they are able to jointly regulate shared tasks, more specifically tasks in the field of transversal mathematical skills and consequently develop self-regulatory learning competences.

3.2. Research questions and objectives

Hargreaves (2003) makes a convincing case for the need to create opportunities for teachers to become knowledgeable professionals, orientated towards research processes, attentive to the problems of practice and able to identify the means and evidence needed to promote a culture of producing and sharing knowledge.

Therefore, this study seeks to analyse how future teachers perceive shared regulation and how, based on experience in the context of pedagogical practice, they promote these skills in children, particularly when solving mathematical problems that are proposed to children. The aim is also to analyse how apprentices in initial training jointly regulate the shared tasks to be implemented and how they support each other, to answer two questions:

How do future teachers perceive shared regulation and self-regulation of learning?

How does the experience of shared regulation in supervised teaching practice promote competences related to solving mathematical problems in a collaborative context in pre-school and primary education?

3.3. Context and participants

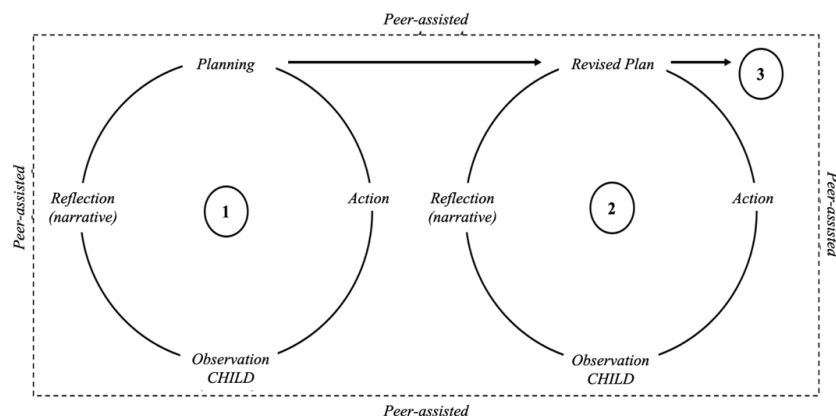
This study involved five 1st year learners in the master's programme in Pre-School Education and Primary School Teaching as part of their Supervised Teaching Practice.

3.4. Data collection and processing processes

3.4.1. Instruments. The instruments used to collect data in this study were focus groups and training narratives. The focus group is a research technique that involves the interaction of a group of representatives from a specific population to discuss a predetermined topic, under the guidance of a moderator. This approach makes it possible to capture a variety of perspectives and processes related to the topic in question, quickly identifying similarities and differences between the participants. Composed of a moderator, an assistant moderator, and a variable number of participants, usually between six and seven, the focus group is a type of interview that seeks to obtain meaningful information within the context of the group's interaction (Amado & Ferreira, 2017). In the context of master's programmes in teaching in Portugal, training narratives from internship reports play a crucial role in the training of future teachers. These narratives allow for in-depth reflection on teaching practices, the development of research skills and a contextualised understanding of the educational reality. They are also a valuable tool for the self-analysis and professional improvement of future teachers (Dias & Pinho, 2020).

3.4.2. Data collection procedure. In this study, a methodology was co-constructed with a group of learners in initial teacher training, focused on promoting self-regulation of learning in children, called "observing and reflecting by narrating in strategic cycles of self-regulated action" (Piscalho, 2021). This method involved collaboration between the participants over a period, based on the idea of shared regulation, mobilising reflective and self-regulation skills, such as planning strategies, action plans, and evaluation, as described by Swartz et al. (2013) as reflective autonomy. In summary, this study was inspired by the self-regulated learning model to describe the participants' collaborative involvement in cycles of instructional change (Zimmerman & Schunk, 2011).

Figure 1. Spiral of strategic cycles of self-regulated action in research.



The spiral of cycles adopted in this study covers the stages of planning, action, observation, and reflection, centered on the interaction between the social and the individual, differentiating it from models of self-regulation that are more focused on the individual. The methodology aims for a dynamic between social and individual learning, influencing the participants' pedagogical practices with the children (Piscalho, 2021). Shared regulation is essential in this process, where group members regulate their collective activity in an interdependent way, sharing strategies, monitoring, evaluation and motivation. This approach is not limited to investigating problems, but seeks effective interventions, approaching action research and allowing flexibility and dynamism throughout the process. The internship participants' investigative process began with the focus group and the training narratives.

3.4.3. Data processing procedure. The purpose of data processing in this study was to analyse and interpret the content of a set of textual data systematically and objectively. This data analysis involved content analysis based on Bardin's (1977) approach. In this context, it is also planned to triangulate the data being collected at different points in the research and using different instruments, thus enabling confirmation and/or validation of the results obtained. We consider that triangulation allows for a comprehensive and robust approach, providing a more complete view of the results and consequently of the study's conclusions.

3.5. Data collection and processing processes

Shared regulation proves to be a crucial element in collaborative training, offering opportunities to develop self-regulatory skills through interactions with others, while at the same time playing a fundamental role in stimulating collective learning.

"I think I'll feel more accompanied in the supervision process, having the opportunity to evolve in a collaborative way." (participant A)

"By better understanding the effects of self-regulation on learning, we will be more committed to teaching these skills to children in this age group. This way we'll become more aware of the processes we use when we teach." (participant B)

It is remarkable to observe how, faced with a challenge, future teachers collaboratively construct possible pedagogical approaches. An example of this is the challenge faced during the distribution of biscuits to the children, a mathematical problem of equitable sharing in the kindergarten context.

"I'd probably choose a child and give them the bag of biscuits and say: now we're going to have to distribute biscuits to all the children and if there are any left-over, we'll give them out again and then we'll see how many biscuits each child got. [The leftover biscuits] could be left over for the next day or I could hand them out again and some children could eat more than others." (participant A)

We believe that training processes based on collaborative learning communities, aimed at improving teaching practices and the quality of student learning, can generate valuable knowledge for maths teaching. The methodology centered on collaborative processes presupposes joint decision-making, information sharing and communication, where the participants, without hierarchy, work together to achieve common goals. Based on a shared task, the future teachers plan to follow an action plan, monitoring progress and collectively evaluating the results obtained.

"In terms of self-regulation, it's important to practise the stages of anticipation, monitoring and evaluation with the children. How are we going to do it? What have we already done? Did it go well or badly? It's important that they actively participate in this process of reflection." (participant B)

"By sharing ideas with each other, we can reach conclusions more easily than if we were alone. It's the same with the children. For example, I think a lot about how they think. Sometimes, instead of giving direct answers, we must respond with questions to stimulate their thinking. Everything is connected, it's a cycle." (participant C)

"When we learn on our own, we start to develop a voice in our head that guides us, remembering previous experiences and helping us to improve. It's similar to children. A secure, self-regulated child is able to fulfil their needs and interests, which often translates into success at school and personal development." (participant E)

The results highlight the importance of this collaboration for the personal, social and professional development of future teachers. The exchange of ideas between participants with different competences was extremely beneficial, breaking down the isolation often felt in individual contexts. The results also indicate that the participants, feeling supported by their colleagues, are better able to regulate the group's activities, making collaborative work a positive experience. However, some challenges were also highlighted, such as false collaboration, which occurs when working together with interests without a common sense of action, and the lack of time for collaboration and reflection.

"This collaborative work will have implications for our practice... this relationship between theory and practice, through shared reflection and discussion, the questioning of practice together alongside the development of our research." (participant A)

"Dialogue, trust and negotiation are fundamental. I even feel safer to take risks, to share my fears and insecurities." (participant C)

"Collaboration provides joint learning, sharing experiences, triggering shared reflection and greater security in our teaching practice." (participant D)

It is essential to emphasise the importance of teachers playing a leading role in the training of their colleagues. There will be no significant changes if the teacher training communities and the teachers and future teachers themselves do not become more permeable and involved. Through pedagogical movements or communities of practice, a sense of belonging and professional identity is reinforced,

which are fundamental for teachers to assimilate the processes of change and transform them into concrete intervention practices.

"It's easier to learn this way. I get very shy when it's individual, but in a group, it gives me some confidence. We learn and become much more confident in the process of practice and research, it makes me feel more comfortable to talk and discuss ideas." (participant A)

"I think that when we're learning in a shared and collaborative way, and even the issues of self-regulation of learning... We have to discuss ideas and, by discussing ideas, we deepen the learning and concepts we already had." (participant C)

"By questioning together, by thinking about our thinking and our actions, we are promoting our self-regulation... We're also working on this skill in ourselves. The five of us are regulating ourselves." (participant E)

4. Conclusions

Shared regulation, involving self-regulation influenced by group support, occurs in collaborative groups and this research has enhanced our understanding of its role in initial and ongoing teacher training. It develops essential skills for (future) teachers to handle collaborative work challenges, fostering creativity and autonomy in problem-solving. Collaborative work is a valued learning resource in education (Ministério da Educação, 2017). Promoting peer support helps regulate shared tasks, making collaborative work an effective learning opportunity. This participant experience should extend to their groups of children in pre-school and primary school. Future research will delve deeper into participant narratives and subsequent stages.

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