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Original Article

# The transactive interaction patterns in middle school students' collaborative-based critical thinking processes aligned with social studies *

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## Abstract

Collaborative-based learning (CBL) has established itself as a respected pedagogical approach in nearly every education system. The success or full potential of such small-group practices largely depends on transactive interactions, which are characterized by both social and cognitive dimensions. This study, grounded in a qualitative methodology and designed as a case study, aims to examine the social and cognitive interaction processes and related experiences of 28 fifth-grade middle school students. These students were assigned to seven collaborative groups and guided to work together on critical thinking tasks aligned with the social studies course. These students were guided to work cooperatively on cognitive tasks related to critical thinking within the context of the social studies curriculum. According to the research procedure, cognitive tasks were developed through a three-phase preliminary process. An implementation model was designed for these tasks, and the activities were conducted in accordance with this model. Data were collected through participants' self-reports (self-assessments, peer assessments, interviews) and the researcher's observation reports during the preparation, orientation, pilot, and primary study phases. The collected data were analyzed in seven stages using MAXQDA Analytics Pro 2024 (version 24.0.0). The findings reflect that socially characterized transactive interactions may be related to students' understanding of collaboration, their socio-emotional awareness and expressiveness, as well as their perceived group well-being. On the other hand, transactive interactions characterized by cognitive features were found to be related to goal orientation, the regulation of idea-generation processes (group metacognition), and the pursuit of high-quality argumentation within the scope of knowledge processing and decision-making. The results are discussed in relation to the classroom reflections of social and cognitive transactive interactions within critical thinking processes based on collaboration. Several recommendations are provided to strengthen both the theoretical and practical frameworks of future research in this field.

## Keywords

Transactive interactions
Shared cognition
Complex cognitive processes
Critical thinking
Collaborative-based learning
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## Introduction

The mechanisms underlying human interactions have long been a topic of fascination (Isaacs, 1933; Smaldino, 2023). From a reductionist perspective, the unique features and nuances of these interactions have drawn attention to learning processes that involve complex thinking (National Research Council, 2000; Tomasello, 2014). Contemporary educational practices position these forms of learning at the heart of classroom interactions, emphasizing the need to enhance the level, quality, and diversity of such interactions as a prerequisite for improving learning processes (Aguilera-Jiménez & Gallardo, 2020). From a pedagogical standpoint, formal interactions in classroom environments are predominantly embedded within CBL frameworks (Davidson, 2022). The impact of CBL on various learning variables has been extensively documented (Ginsburg-Block et al., 2006; Hu et al., 2021). Furthermore, it has been repeatedly demonstrated that CBL enables students to structure and critically analyze each other's thoughts, thereby fostering, facilitating, and enhancing critical thinking (Hajhosseini et al., 2016; Xu et al., 2023). The nature of critical thinking is inherently interactive (Halpern, 2014); students often require input or responses from others in order to question their own thinking or ground it in logical reasoning. In CBL groups, this partnership—or social contract—between students is tightly integrated into patterns of social and cognitive processes, which form the core of transactive interactions.

### *Background*

#### *Transactive Interactions Through CBL*

CBL is an instructional approach that not only allows students to reflect upon and deepen their own knowledge but also enables them to engage meaningfully with others (van Boxtel & Roelofs, 2001). Within this approach, assumptions regarding how learning groups attain different performance levels tend to synthesize the social and cognitive dimensions of knowledge processing (Tindale et al., 2008). The core of this synthesis lies in transactive interactions (Jurkowski & Hänze, 2010; Nemeth et al., 2023). The term transactive is defined as "reasoning that operates on the reasoning of another" (Berkowitz & Gibbs, 1983, p.402). The foundation of transactive interactions involves learning partners (or group members) referencing the knowledge and meaning provided by others, expanding upon it, transforming it into detailed thinking, and integrating it with their own thoughts (Jurkowski ve Hänze, 2010; Jurkowski et al., 2022). In this context, the concept of "transactive interaction" denotes that knowledge and meaning are constructed through interpersonal exchanges.

The conceptual and theoretical structure of transactive interactions is frequently associated with the approaches of Dewey (1933), Piaget (1952, 1971), and Vygotsky (1962, 1978). According to these perspectives, knowledge and meaning are constructed through reciprocal interactions among individuals, particularly in contexts conducive to logical thinking and reasoning. A number of studies that focus on interaction processes in CBL settings have largely supported this view (Bales, 1950; Liu & Tsai, 2008). On this basis, transactive interactions are inherently dynamic processes in which social and cognitive dimensions are deeply intertwined. Social interactions pertain to the perceived mutual response processes among students within the group context (Coie et al., 1982). Prior research has shown that the balance of learners' approaches to collaboration, as well as the temporary relationships they establish, determine whether the group can engage in more complex and deeper thinking processes (De Laat & Lally, 2004). Cognitive interactions, on the other hand, involve the process through which students co-construct shared meanings related to the task (Hernández-Sellés et al., 2020). Transactive interactions primarily seek to explain this cognitive dimension.

According to conceptual classifications, the behaviors that constitute transactive interactions (transacts) can be divided into two dimensions: representational and operational (Berkowitz & Gibbs, 1983; Berkowitz et al., 2008). Representational transacts are limited in scope and quality, such as merely repeating or adhering to the reasoning processes of others, and do not significantly advance the group's reasoning. In contrast, operational transacts build the foundation of an idea, strongly contextualize it, transform it, and enhance the reasoning processes of other group members. Because transactive interactions involve discourse forms that lead to cognitive change, they are inherently intensive and demanding (Hänze & Jurkowski, 2022; Nemeth et al., 2023). For an optimal transactive interaction process, it is emphasized that mental preparation must be made before engaging in dialogue by considering the social context and environment (Frith & Frith, 2006; Kuhlen et al., 2017). Additionally, sustaining such interactions requires continuous attention to the ongoing conversation, retention of ideas in memory, critical analysis of context, and the reorganization of mental representations accordingly (Mojzisch et al., 2014). This is particularly critical for CBL groups (Ouyang et al., 2023), because if these social and cognitive processes are not well-organized, the information-processing mechanisms required for critical thinking become vulnerable to various forms of faulty reasoning (Battersby, 2016; Dwyer, 2023).

#### *CBL and Complex Cognitive Processes*

CBL and other pedagogical practices within this context operate as an integration of both social processes (such as understanding others and perspective-taking, i.e., mentalizing) and complex cognitive processes (e.g., reasoning, problem solving, critical thinking, decision making) (Gross & Medina-DeVilliers, 2020). According to theory of mind (Frith & Frith, 2006) and social information processing theory (Crick & Dodge, 1994), this integration involves understanding others' intentions, interpreting their thoughts, and applying cognitive regulation (Nelson et al., 2005). Neuroscientific studies have identified connections between brain regions activated during collaborative (social) behavior and those involved in processing complex information (Mitchell et al., 2004; Stallen & Sanfey, 2015). As the social load on the brain increases, the activation of medial (MFP) and lateral frontoparietal (LFP) systems also increases (Meyer et al., 2012). Parallel to this, abstract reasoning tasks performed through social interaction, such as collaboration, are believed to enhance the efficiency of cognitive processing in the brain (Davidesco et al., 2019; Dikker et al., 2017; Pan et al., 2018; Prado et al., 2020).

This body of research suggests that collaborative learning may lead to better learning outcomes than individual learning in the context of complex cognitive tasks (Ginsburg-Block et al., 2006; Olivera & Straus, 2004). In complex cognitive tasks, CBL offers several affordances, such as the integration of prior knowledge (Zambrano et al., 2019), coordination of working memory resources (Du et al., 2022; Sankaranarayanan et al., 2021), and distribution of cognitive load (Kirschner et al., 2009). The role of CBL as a regulator between social and cognitive interactions highlights its critical importance for fostering critical thinking (Frith & Frith, 2012; Sawyer et al., 2017; Trouche et al., 2014; Trung & Truong, 2023).

#### *Transactive Interactions and Critical Thinking in Groups and Dyads*

Critical thinking involves consciously focusing on reasoning processes and formalizing thought (Facione, 1990; Paul & Elder, 2006). This formalization process entails making judgments and choices among alternatives based on specific criteria (Wang & Ruhe, 2007). A broad body of research literature links such factors that may influence critical thinking in groups or dyads to the transactive spread or dialogic network structures observed in CBL groups (Felton et al., 2015; Gätje & Jurkowski, 2021; Heyman, 2008). In this regard, Liu and Tsai (2008) identified five forms of transactive propagation: centralized and distributed information exchange, group development obstacles, ability obstacles, and partial information exchange. Their findings show that high academic achievement and heterogeneous abilities do not necessarily guarantee strong cognitive performance. Indeed, some high-achieving groups performed poorly due to passive interaction processes. Further analysis using probabilistic models such as first- and second-order Markov chains revealed that while students actively supported correct suggestions in groups and dyads, they were also inclined to accept and propagate incorrect ones. Moreover, although students were more adept at detecting errors or gaps in correct suggestions, their ability to question or correct incorrect suggestions remained limited (Nemeth et al., 2023). These findings imply that while transactive interactions may enhance information flow among students, they may also facilitate the unnoticed circulation of incorrect information within the group. Therefore, transactive interactions are highly functional phenomena that warrant further investigation, especially in learning groups engaged in complex cognitive tasks like critical thinking.

***The Present Study***

Many school-based implementations fall short of leveraging the potential of CBL (Christie et al., 2009). This shortcoming often stems from the assumption that placing students in groups will automatically yield meaningful interactions. However, a substantial body of research has highlighted that simply grouping students does not guarantee the emergence of expected meaningful interactions (Dillenbourg, 1999; Veldman et al., 2020). In this regard, Baines et al. (2003) emphasize that in many group learning applications, students tend to operate independently, often neglecting peer-to-peer interaction. The success and transformative potential of CBL lies precisely within these interaction processes. However, how students interact in CBL groups—what processes they use to generate ideas or how they develop understanding and insight—remains insufficiently understood. While prior research has frequently emphasized the relationship between transactive interactions and higher-order thinking skills such as academic achievement, cognitive performance, and critical thinking (Hunter & Anthony, 2014; Jurkowski & Hänze, 2010; Webb, 1984, 2008; Yager et al., 1985) there is still a lack of comprehensive studies that systematically reveal the characteristics of transactive interactions among students within group learning contexts. This study represents the first research effort in Türkiye focusing specifically on transactive interactions. Addressing this gap and gaining a deeper understanding of how CBL functions is a critical step in contributing to the existing literature. The aim of this study is to examine the interaction processes and associated experiences—both social and cognitive—of fifth-grade middle school students working collaboratively on cognitive tasks designed to promote critical thinking in a series of social studies lessons. While social and cognitive interactions cannot be strictly separated, this research focuses on the characteristic elements of both domains.

***Research Question and Sub-Questions***

This study seeks to answer the following main research question: "What are the patterns of transactive interactions in the critical thinking processes of middle school students during collaborative activities associated with social studies?" To address this overarching question, the following sub-questions are posed:

1. What group dynamics or student characteristics—socially oriented—guide the interaction processes of fifth-grade students while they collaboratively engage in cognitive tasks related to critical thinking, and how do these explain the structure of their transactive interactions?
2. What group dynamics or student characteristics—cognitively oriented—guide the interaction processes of fifth-grade students while they collaboratively engage in cognitive tasks related to critical thinking, and how do these explain the structure of their transactive interactions?

## Method

### *Research Design and Participants*

This study is grounded in a qualitative methodology that aligns with post-positivist, social constructivist, or other interpretive paradigms (Creswell, 2013). The interaction patterns that emerged during students' collaborative critical thinking processes were examined through a case study design. As a flexible methodological approach, case studies are particularly well-suited for in-depth investigations of specific instructional processes or pedagogical practices in educational research (Creswell, 2013; Merriam, 1998; Mills et al., 2010). This design is also effective for exploring the behaviors of individuals interacting within a shared context (Debout, 2016). The study was conducted with 28 fifth-grade students at a public middle school in northern Türkiye. The school was selected to represent typical urban educational settings in the region, ensuring both accessibility and a degree of academic and demographic diversity. Participants were selected using a purposive strategy (Palys, 2008; Patton, 2002) based on criteria such as developmental appropriateness, grade level, accessibility, and demonstrated active participation in collaborative processes. Participants had a mean age of 11 years.

### *Group Balance*

Without intervening in the pedagogical context or the natural modes of student interaction, the groups were structured to ensure a context of interaction appropriate to the conditions in terms of both size and equality. Meta-analyses and empirical studies have shown that optimal transactive interactions frequently occur in dyads (Kim et al., 2020) and in groups of four (Corrégé & Michinov, 2021). In this study, drawing on the group size approach of Johnson et al. (1994)—which posits that in a single logically sequenced round of interaction, dyads engage in two interactions and groups of four in twelve—seven collaborative groups (G1, G2, … G7), each consisting of four students (S1, S2, … S28), were formed to facilitate context-appropriate transactive exchanges. The final decision regarding the equality of the groups (Hooper & Clariana, 2012; Hwang et al., 2008; Johnson et al., 1994) was made based on pilot implementations data and the professional judgments of the school counselor, the classroom teacher, and the social studies teacher.

### *Procedure*

#### *Preliminary Steps*

To identify patterns of transactive interactions, participants were guided through various critical thinking cognitive tasks. These cognitive tasks were developed in three stages aligned with the social studies curriculum. In the first stage, studies integrating CBL techniques with critical thinking skills (Criterion A) and studies defining at least one specific critical thinking skill (or subskill) (Criterion B) were systematically reviewed based on inclusion and exclusion criteria. According to Criterion A, 13 CBL techniques and 22 critical thinking skills were examined across 15 studies. According to Criterion B, 35 distinct critical thinking skills were analyzed in 14 studies. In the second stage, the cognitive tasks were determined, and in the third stage, expert reviews, pilot implementations, and subsequent revisions were conducted.

#### *Critical Thinking Cognitive Tasks*

The critical thinking cognitive tasks (P) were implemented over five periods (P1, P2, P3, P4, P5), requiring a total of 15 hours. These tasks were structured around techniques such as Think-Pair-Share (2x), Team-Pair-Solo (2x), and Jigsaw (1x), and were aligned with skills related to evidence-based reasoning and inquiry, inference through comparison, distinguishing the presence or absence of relationships among propositions, and causal explanation. Each task also incorporated various subskills relevant to critical thinking.

#### *Implementation Model*

The collaborative critical thinking cognitive task model is illustrated in Figure 1.

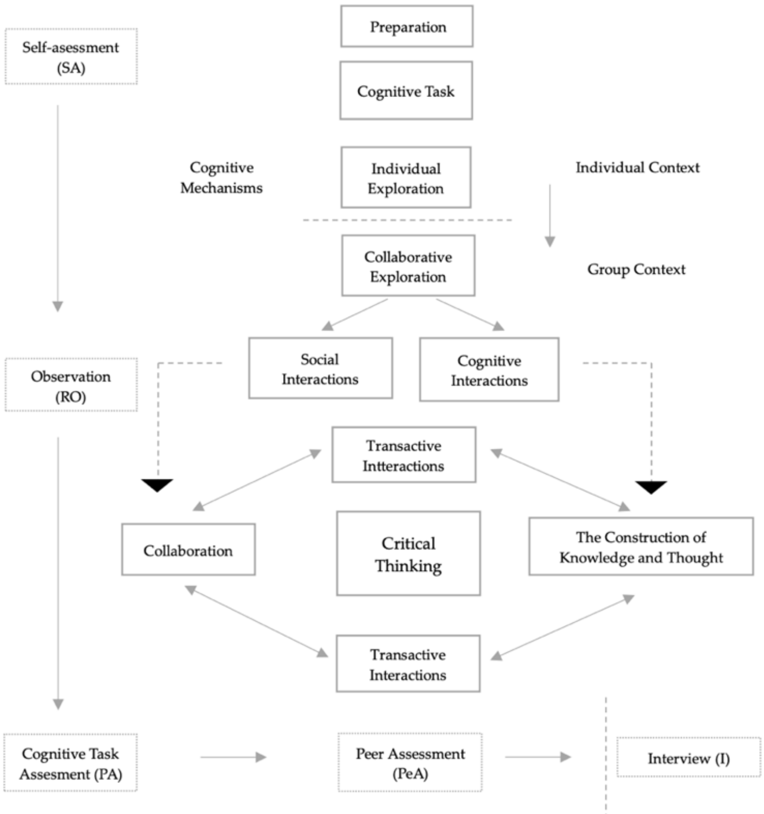


**Figure 1**. A step-by-step representation model of the functioning of collaborative critical thinking cognitive tasks and the data collection process

According to Figure 1, a critical thinking cognitive task consists of two stages. The "Individual exploration" stage includes processes such as preparing students for the activities, explaining social and cognitive interaction standards, etc. The "Transactive exploration" stage involves students' transactive interaction and active thinking processes. This stage includes the collaborative structuring of critical thinking cognitive tasks in groups and dyads (leveraging the power of social dynamics) and the deepening of knowledge and thought (transforming ideas into a new form). The cognitive tasks were designed to encourage transactive interactions. The questions included in the cognitive tasks were prepared in a way that supports the functionality of the model in Figure 1, ensuring that students participate in collaboration processes and stay within the critical thinking context. The cognitive tasks in critical thinking include questions such as “Prof. Filiz, after attending a meeting and discussing with Prof. Albert, thinks that Sahhen and Rado were wrong. What convinced Prof. Filiz? Was it the right decision for Prof. Filiz to change her mind?” (P1), “Who wrote the most suitable or helpful answer to Ozan_52's question?” (P3), “The two authors of the texts disagree on the role of plastics in human life. What is the key point of disagreement between the authors?” (P5).

***Instruments***

The data were collected through 2 categories and 5 different methods, based on participants' self-reports; sociometric and cognitive self-assessment (SA), cognitive task assessment (PA), peer assessment (PeA), interviews (I), and researcher observations (RO). Instruments were developed in 7 steps during the expert review and pilot implementations cycle (systematic literature review, creation of general question and expression matrices, determination of their structure and function, categorization, creation of specific question and expression matrices, expert opinion and pilot implementation cycle for each instrument, periodic language adjustments). The sociometric and cognitive self-assessment instrument ensured that students defined certain social and cognitive characteristics before the first application period. The cognitive task assessment instrument allowed participants to subjectively assess the personal cognitive experiences they had during the assigned tasks. The peer assessment instrument enabled students to evaluate the contributions to cognitive tasks and the quality of interactions through their peers. The interview instrument facilitated in-depth understanding of interaction processes and helped uncover details that were difficult to capture with other instruments. The observation instrument provided standardized structures for systematically observing real-time interactions and behavioral patterns in their natural context. A subset of questions from the instruments, along with their conceptual descriptions, is presented in Appendix 1. Due to the nature of qualitative data, and in line with Maxwell's (2013) recommendations to reduce bias and reactivity, care was taken to avoid questions and expressions that indicated a particular theory or were based on any pre-determined preference. This process was conducted with great attention to ensure neutrality. Neutrally structured questions allowed participants to express their experiences (understandings, interpretations, feelings, etc.) in their own words.

***Data Collection***

Data were collected following several phases: the preparation phase (including the scheduling of the study, parent meetings, and other planning activities), the orientation phase, pilot implementations, and the main study phase. During orientation, students first engaged in the "determination of academic tasks," which involved theoretical instruction on collaborative learning and critical thinking skills. This was followed by the "example simulation" phase, in which students applied these theoretical concepts in real-life contexts. During the pilot implementation phase, the suitability of research questions, cognitive tasks, and instruments was tested according to specific criteria and revised accordingly. As a result of these phases, an implementation model explained in Figure 1 was developed for the primary study, and data were collected in accordance with this model. Prior to P1, SA data were collected once. During each cognitive task period, RO, PA, and PeA data were collected as standard. Interview data were collected during the 3rd and 5th weeks of the implementation process in a two-phase manner (with all participants and random selections). All data were processed into forms prepared on iPads, structured according to the groups, and then matched with the recordings, later being confirmed by the students.

***Data Processing and Analysis***

This study employed a content analysis approach based on established qualitative research principles (Drisko & Maschi, 2015; Kyngäs, 2020). Although content analysis strategies vary, the analytical framework recommended by Creswell (2012) and Creswell and Poth (2018) was adopted due to its systematic structure and applicability to the data. Data were analyzed using the MAXQDA Analytics Pro 2024 (version 24.0.0) software, which allowed for the exploration of complex relationships and patterns (Kuckartz & Rädiker, 2019). A data analysis matrix is shown in Figure 2.

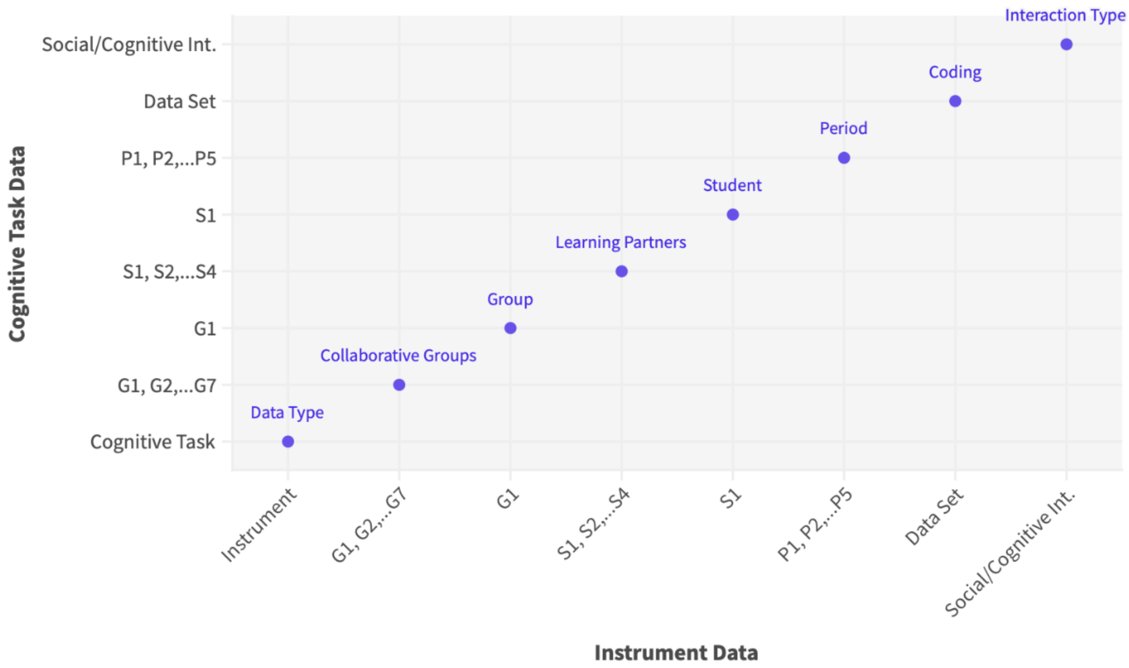


**Figure 2.** Example of Data Analysis Matrix

All student data were transcribed verbatim into sentences, each containing a single proposition, and then transferred into MAXQDA Analytics Pro 2024. The data sets were divided into two document systems: cognitive task data and instruments data, and sub-document groups were created accordingly. Document groups were categorized based on data type, CBL groups, individual groups, learning partners, individual students, and cognitive task periods. The data types were defined, and the data were classified according to collaborative groups. An analysis group was identified, and the data of the four learning partners in this group were consolidated, after which the data of the student to be analyzed were placed into the analysis matrix according to the cognitive task period and the type of data collection instrument. Based on this matrix, the data were processed in MAXQDA Analytics Pro 2024, and this process was repeated cyclically for the 7 groups, 28 students, and 5 cognitive tasks. In this way, cognitive task and instruments data were analyzed comparatively. Information regarding the functioning of transactive interactions was embedded in various codes — the code system representing these information sets is shown in Appendix 2. Independent and related code matrices, along with information pieces, were transformed into upper and lower codes, and initial patterns were identified. Poor quality codings were eliminated, and low-frequency sub-codes (usually 5 or fewer) were synthesized at the upper code level according to context. Categorical classifications were made to re-identify the patterns. The categorized and reviewed data files were sent to multiple coders for inter-coder agreement, and requests for review and coding were made to ensure the stability of the analyses. The inter-coder agreement was determined to be 93.57%. It is recommended that this agreement be above 80% (Saldana, 2021). Codes with sufficient agreement percentages were organized into meaningful units, patterns were re-identified, and the analyses were completed.

***Limitations***

This study has four main limitations. First, it is limited to the students who comprised the study group at the middle school where the interventions were conducted during the 2023-2024 academic year. Second, due to its post-positivist design, inherent methodological constraints restrict the generalizability of the findings. Third, the results are confined by the scope of the data collection tools, which consisted of student self-reports and observation-based forms. Finally, excluding orientation and pilot phases, the study was conducted over a period of five weeks, which may be insufficient to capture long-term trends in students' collaborative critical thinking interactions. Therefore, the research has limitations in providing a comprehensive understanding of how the observed phenomena evolve over time.

#### *Ethical Issues*

This study was conducted with the ethical approval of the Social and Humanities Research and Publication Ethics Committee of the Rectorship of Kastamonu University, dated 07.09.2022, and decision number 9/2, as well as the permission of the Governorate of Ordu, dated 11.09.2023, with reference number E-18802389-605.01-83541134.

## Findings

#### *Findings Regarding Sub-Problem 1*

The analyses indicate that socially characterized transactive interactions in collaboration-based critical thinking tasks are associated with the understanding of collaboration, socio-emotional awareness and expressiveness, and the perception of social well-being within the group.

#### *Understanding of Collaboration and Tendencies Toward Collaboration*

The understanding of collaboration and students' disposition toward collaborative work constitute the primary and most influential dimension of socially characterized transactive interactions. A willingness to engage in collaboration or an effort to establish partnerships regardless of other conditions was categorized as positive collaboration, whereas avoidance of collaboration or expressing concerns about forming partnerships was classified as negative collaboration. Students' conceptualization of collaboration guided them to act jointly with the group (collective), independently from the group (individual), or with specific peers (dyadic). The most frequently coded data pertained to this theme. In total, 363 transactive interactions related to collaboration were identified, of which 185 were associated with positive collaboration and 178 with negative collaboration. Data from Groups 1, 2, 4, and 5 accounted for 87.57% (162 interactions) of the positive collaboration instances, while data from Groups 3, 6, and 7 represented 12.43% (23 interactions). In contrast, the negative collaboration category included 44 interactions (24.72%) from Groups 1, 2, 4, and 5, and 136 interactions (76.40%) from Groups 3, 6, and 7. This grouping, or dichotomization, of collaboration understanding was also broadly mirrored in the patterns of other transactive interaction processes. The findings from both research questions generally aligned with this categorization.

#### *Social-Emotional Awareness and Expressive Capacity*

Social-emotional awareness and expressive capacity constitute the second characteristic dimension of socially characterized transactive interactions. In this domain, students' abilities to make social inferences—particularly through body language, facial expressions, speaking style, tone of voice, and emotional cues such as frustration and sadness—played a significant role in shaping transactive interaction processes. When social inference skills were used effectively, students exhibited proactive behaviors such as attempting to resolve potential conflicts before they escalated, investing effort into understanding the intentions and feelings of others, and using motivating elements such as social rewards. The following student statements illustrate these dynamics:

> "...Actually, if someone has difficulty expressing themselves, I try to help... I look at their face and try to understand how they feel. I try to find a solution together so they can express themselves better." (G2, S7, PA)

> "...Their ideas sound strange (and silly). If everyone criticizes them, they might feel really bad... When one of my friends noticed this, and told them they were part of our group, it reflected on them... This way, everyone can do better. I think we need to understand each other..." (G4, S11, PA)

> "...When I realize they're struggling, I sometimes try to encourage them to join us... When I saw a groupmate constantly feeling bad, I said, 'Awesome! You're doing great, buddy!'" (G6, S27, I)

Groups that demonstrated effective use of social inference skills more frequently displayed behaviors such as respectful attitudes (avoiding condescending or superior behavior), active listening, building constructive relationships, and openness to feedback. A total of 111 transactive interactions were identified in relation to this theme. Of these, 99 interactions (89%) were observed in data from Groups 1, 2, 4, and 5, while only 12 interactions (11%) came from Groups 3, 6, and 7.

***Groups Ineffective in Using Social Inference Skills***

Groups that were less effective in utilizing social inference skills more frequently displayed behaviors such as withdrawal and difficulty in self-expression, poor emotional regulation, social disengagement, feelings of exclusion and worthlessness, and the exertion of knowledge dominance (bullying). A total of 111 transactive interactions were identified regarding this dimension. Of these, 89 interactions (66%) were recorded in data from Groups 3 and 7, while 45 interactions (33%) were observed in Groups 1, 2, 4, 5, and 6. Selected student reflections related to this theme are presented below:

> "I think we were the group that failed at this. For example, when they kept finding what I said ridiculous, it made me angry. So this time, I didn't say much until it was over... I didn't get too involved. To be honest, nobody cared either. That made me even more upset." (G3, S10, I)

> "...Sometimes my opinions weren't taken seriously. They acted like it didn't matter whether I was there or not... I felt a bit insignificant in our group, to be honest. Maybe that's why I stayed quiet. Even though I'm confident, I found it hard to talk to them at times." (G7, S9, PA)

> "...Since he's normally a quiet, calm person, I don't think it was a problem that he didn't join us." (G7, S6, PA)

These statements, when evaluated in terms of social inference skills, highlight that some group members failed to adequately perceive the emotional and social cues in their interactions with peers.

***Perceived Social Well-Being Toward the Group***

Perceived social well-being toward the group constitutes the third characteristic dimension of socially characterized transactive interactions. Students' sense of harmony with their peers, their satisfaction in working together, and their friendships played a decisive role in shaping their social interaction processes. This dimension is closely related to self-esteem, group self-discipline, internal state experiences, and the quality of interpersonal connections.

Self-esteem was manifested in the form of confidence and the ability (or difficulty) to express oneself or withdraw from group interactions. In groups where members perceived a strong sense of harmony, higher levels of confident behavior were observed. Conversely, in groups lacking such a sense of cohesion, confidence-related behaviors were markedly less frequent. In high-confidence groups, students felt more mentally comfortable, which allowed them to express their thoughts more freely—contributing greatly to the depth of cognitive interaction. On the other hand, in groups with low confidence behaviors, students often felt mentally uneasy. This unease increased their anxiety about being criticized, humiliated, or not being able to assert themselves within the group, leading to difficulties in self-expression and withdrawal behaviors.

Group self-discipline and internal state experiences emerged through concepts such as group flow, suboptimal experiences, strong versus weak group discipline, internal versus external motivation, ability to cope with challenges, and lack of social motivation. Group flow and suboptimal group experiences were especially important. Group flow was defined as the enjoyment derived from spending time together and working as a team. Groups that demonstrated this tendency showed strong group self-discipline (e.g., collective will, organization, and focus) and operated with intrinsic motivation, making more effective use of their collective potential and human resources. In contrast, suboptimal experiences referred to dissatisfaction with group interactions. These groups tended to display weak group self-discipline (e.g., poor sense of responsibility, disorganized structure, and fragmented task handling) and lacked social motivation. Below are selected student reflections illustrating these tendencies. The first reflects group flow and strong self-discipline, while the second exemplifies a suboptimal experience and weak group discipline:

> "...Everyone was really motivated. Even the quietest and least successful student in our class was in our group—he read every single question out loud. He didn't fall behind at all..." (G2, S5, PA)

> "...Teacher, it felt like we were strangers to one another. There were a few people helping with the questions, but for the most part, everyone kept to themselves. For example, after working on things alone, I asked for help where I was struggling: 'Can you help me with this?' But overall, we kind of just handled things on our own. I don't think we fully supported one another." (G3, P8, I)

Extremes in social relationships—whether in the form of overly close friendships or difficulties in forming emotional or social bonds with the group—were both found to negatively impact transactive interaction processes. Overly close friendships hindered the objective exchange of ideas within the group. For instance, although Groups 4 and 5 generally exhibited relatively high levels of both social and cognitive interaction, excessively close friendships occasionally undermined their transactive interaction processes. Conversely, difficulties in establishing social or emotional connections with group members also disrupted the natural flow of these interactions. These challenges often resulted in fragmented communication and reduced cooperative behavior. Below are selected student reflections illustrating these issues. The first quote relates to overly close friendships, while the others exemplify challenges in forming social and emotional connections with the group:

> "...I don't criticize my best friend, even if I want to. Even if they make mistakes, I don't say anything. For example, one of my friends contributed less, but I didn't say a word to them..." (G5, S21, PeA)

> "Some people were hiding information. I think they didn't like us very much, so they kept their answers from us. I asked what was written in one section, and no one looked. But when someone else asked, they all answered..." (G3, S8, PeA)

> "...They want to help their friends in the other group more than us. That's why we got most of the warnings." (G4, S22, PeA)

These reflections underscore how extreme social dynamics—whether stemming from excessive closeness or emotional detachment—can weaken collaborative structures and hinder the creation of an effective sharing environment within groups.

***Findings Regarding Sub-Problem 2***

The analyses indicate that cognitively characterized transactive interactions in collaboration-based critical thinking tasks are associated with goal orientation, the regulation of thought production processes (group metacognition), as well as knowledge processing and decision-making.

***Goal Orientation and Regulation of Idea-Generation Processes***

Goal orientation and the regulation of idea-generation processes constitute the first characteristic dimension of cognitively oriented transactive interactions. Goal-directed tendencies were categorized into goal-oriented behaviors (163 interactions), competence-oriented behaviors (70 interactions), and goal-detached behaviors (113 interactions), resulting in a total of 346 interactions. The regulation of idea-generation processes was observed through two primary categories: metacognitive awareness and monitoring (160 interactions) and limited metacognitive awareness (160 interactions), totaling 320 interactions.

More frequent goal-oriented, competence-oriented, and metacognitive monitoring behaviors were identified in Groups 1, 2, 4, and 5 compared to others. Conversely, goal-detached behaviors and limited metacognitive awareness were more prevalent in Groups 3 and 7. These differences were particularly striking. For example, 25.34% of all goal- and competence-oriented interactions occurred in G1 (92 interactions), while only 1.78% occurred in G7 (7 interactions), and 0.76% in G3 (3 interactions). In contrast, 60% of the goal-detached and limited metacognitive awareness interactions were observed in G3 (96 interactions), 43.12% in G7 (69 interactions), and only 7.5% in G5 (12 interactions).

Groups' orientations toward goals influenced their seriousness, persistence, and ability to adapt to changing conditions (e.g., confronting challenging questions). Groups demonstrating goal-oriented behaviors tended to avoid a purely performance-based approach (e.g., aiming solely for high scores). In contrast, goal-detached behaviors led to deviations toward irrelevant topics (e.g., off-topic comments), prioritization of personal traits over group goals (e.g., ad hominem remarks, efforts to prove oneself), and, most critically, a focus on merely providing a correct answer without depth or quality.

The regulation of idea-generation processes closely paralleled goal orientation. Groups with strong goal orientations displayed higher levels of metacognitive awareness by effectively monitoring the roles of other group members, detecting and correcting errors, and directing others' thinking processes—much like monitoring one's own. Students in these groups actively guided peers with comments such as, "Could you be missing something here?", "Does this solution really make sense?", or "There's something going wrong, don't you think?" Furthermore, they were more capable of identifying which cognitive strategies worked—or didn't work—within task contexts. On the other hand, groups with limited metacognitive awareness (typically those exhibiting goal-detached behaviors) struggled to monitor their peers' thinking processes, even if they made efforts to complete the critical thinking tasks. Analyses showed that these students often expressed ideas without fully understanding the task context, had difficulty recognizing and analyzing different perspectives, and failed to determine which viewpoints were most appropriate. They frequently relied on previously unsuccessful strategies (e.g., repeatedly rereading all text passages for each question), indicating a lack of adaptive regulation in problem-solving processes.

***Knowledge Processing and Decision-Making Processes***

Knowledge processing and decision-making processes constitute the second and most critical characteristic dimension of cognitively characterized transactive interactions. The interactions in this domain manifested as the exchange of knowledge, ideas, and arguments, emphasizing a shared pursuit of high-quality arguments. The relevant codes and the distribution of interactions are presented in Figure 3.

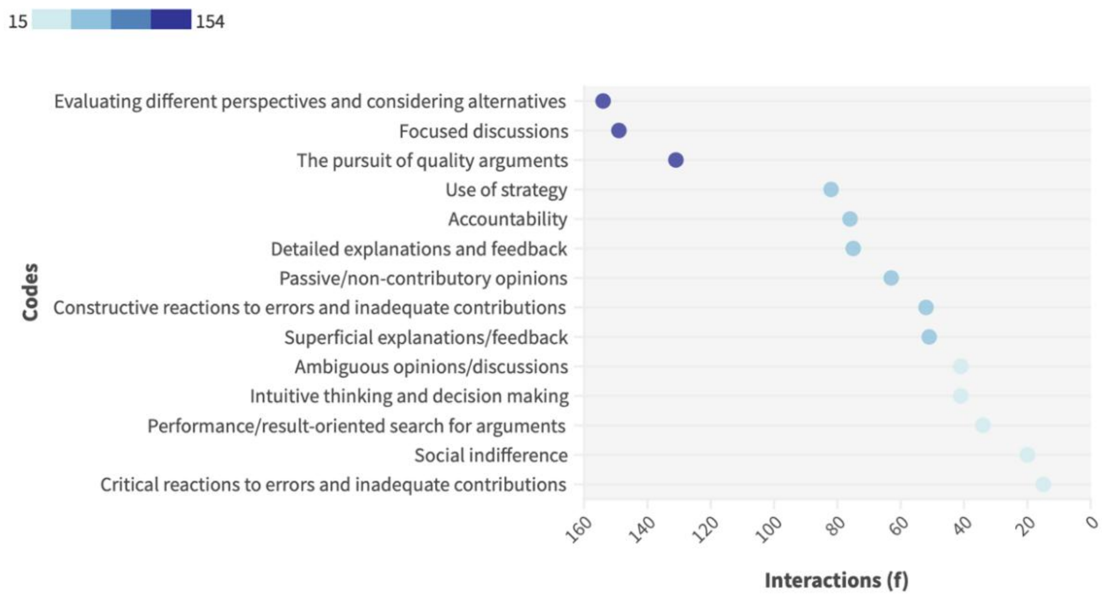


**Figure 3**. Codes Related to the Theme of Knowledge, Ideas, and Arguments Exchange and the Frequency Distributions of Interactions Defined by These Codes

Hundreds of interactions centered on the exchange of knowledge, ideas, and arguments among groups were clustered under various distinct codes. Characteristics that promote strong cognitive interactions (e.g., evaluating diverse perspectives and reviewing alternatives, seeking quality arguments, providing detailed explanations and feedback) as well as those that lead to weak cognitive interactions (e.g., passive and non-contributory opinions, performance/result-oriented argumentation, intuitive thinking and decision-making) have been identified. According to the code relationship analysis, strong cognitive interactions were most closely associated with the code for seeking quality arguments. Therefore, it was determined that interactions related to knowledge, ideas, and arguments exchange primarily focused on seeking quality arguments.

Quality argument exchange is defined as the effort to make responses to cognitive tasks related to critical thinking more qualified while fulfilling these tasks. This involved understanding the perspectives of group members, identifying ideas that contribute to solutions, using or eliminating them, producing solid and persuasive evidence and alternatives, responding constructively to mistakes, and using basic strategies.

In Table 1, the distribution of interactions related to seeking quality arguments across the groups in the cognitive tasks P1 “Sumerians: A Journey in Search of the Mysterious History of Writing” and P2 Welcome to “Kids Are Talking” YouTube Channel! is presented, and in Table 2, the responses provided by the groups to some questions in these cognitive tasks under the common decision-making condition are shown.

**Table 1.** Distribution of Interactions Related to the Pursuit of Quality Arguments in P1 and P2 Cognitive Tasks Across Groups

| Groups | Pursuit of Quality Arguments |
|---|---|
| G1 | 44 |
| G2 | 30 |
| G3 | 3 |
| G4 | 28 |
| G5 | 18 |
| G6 | 6 |
| G7 | 8 |
| Total | 131 |

**Table 2.** Common Responses Provided by Groups to Certain Questions in P1 and P2 Cognitive Tasks

| **P1** | **Sumerians: A Journey in Pursuit of the Mysterious History of Writing** |
|---|---|
| CT Skill | Evidence-Based Reasoning and Inquiry |
| Question | “Prof. Filiz finds Sahhen’s thoughts more convincing than Rado’s. Why might this be? Write your answer using evidence from the text. |
| | Responses |
| G1 | "He has more knowledge than Sahhen. Sahhen is more aware than Rado. Rado is a rug maker, while Sahhen is a guide. Sahhen is more knowledgeable." |
| G5 | "The fact that Sahhen is a local guide shows that he has to know the subject. He already demonstrated that he knows the subject better. He even gave an example: People living in big cities might have needed writing to prevent problems. This explains why Sahhen believes this." |
| G3 | "The large number of people might have been influential." |
| G7 | "They both said the right things, but Prof. Filiz may not have believed [Rado] enough." |
| Correct Answers | Answers emphasizing Sahhen’s knowledge will be considered correct. |
| **P2** | **Welcome to “Kids Are Talking” YouTube Channel!** |
| CT Skill | Inference Through Comparisons |
| Question | One of the purposes of the text titled Welcome to “Kids Are Talking” YouTube Channel! is to compare the cultural and historical significance of Hagia Sophia with other churches. What is the other purpose of this text? |
| | Responses |
| G2 | “The natural areas around Hagia Sophia are being destroyed, and it explains the changes over the past 40 years. It mentions how the natural areas around Hagia Sophia are being destroyed and how the structures' historical genetics can be damaged over time." |
| G4 | "To prevent damage to the surroundings of these buildings. Because an important change occurred recently in the picture. The surroundings of the Taşbaşı church in Ordu have become filled with houses. I live there too. I will tell my dad that we need to move, teacher." |
| G6 | "To introduce historical places to people." |
| G7 | If we want them to last longer, we must protect the buildings." |
| Correct Answers | Answers highlighting the protection of historical sites from human destruction will be considered correct. |

When Tables 1 and 2 are considered together, it is observed that groups that engaged in more intense cognitive interactions related to the search for quality arguments provided more accurate, consistent, detailed, and longer responses in terms of word count. In contrast, groups that experienced fewer interactions on this matter gave shorter, contextually disconnected answers with a more limited knowledge base.

This situation, though not frequent, was sometimes related to how groups behaved when they were unable to reach consensus during the decision-making process, particularly in situations where group members had to take initiative. When a positive dominance was adopted in the groups, the student who relied most on background knowledge made decisions by pressuring others. However, when group thinking was adopted, the ideas presented by the dominant group member were often accepted without question.

These findings show that collaboration-based critical thinking processes are highly sensitive to transactive interactions, and this process creates localized and complex behavioral patterns.

## Discussion, Conclusion, and Recommendations

One of the principles of CBL is transactive interactions among learning partners. The momentum of transactive interactions is largely related to the understanding of collaboration, which itself is a learning outcome for collaborative-based pedagogical practices (Slavin, 2014). Schwarz et al. (2000) highlighted that students' success in group work depends on a series of conditions, which can be triggered by the optimal understanding of collaboration. Gillies (2014), who examined the research findings of Schwarz et al. (2000) and similar studies more deeply, argued that responding to a collaborative cue in collaborative learning groups forms the contextual foundation for group-specific behavioral patterns. This study concluded that the understanding of whether to sustain or avoid collaboration during cognitive tasks focused on critical thinking significantly alters the nature of transactive interactions. Groups with a dominant positive understanding of collaboration, defined as an effort to form partnerships while being open to collaboration and ignoring other conditions, generally had better experiences related to both social and cognitive transactive interactions throughout the entire research process. These results align with previous studies that emphasize the importance of the understanding of collaboration in group work (Hancock, 2004; Hunter & Anthony, 2014; Roseth et al., 2008). In one study, it was found that the mathematical thinking processes of students aged 8-12 developed through social collaboration dialogues in groups (Hunter & Anthony, 2014). Initially, 74% of the dialogues were related to cognitive tasks, but as social collaboration dialogues developed, this rate increased to 96%. However, it is well-known that simply placing students in groups and telling them to work together does not necessarily encourage collaboration in collaborative learning (Veldman et al., 2020). When students with different characteristics or tendencies are required to work together, many factors need to be managed in harmony, which complicates and makes the collaboration process more difficult (Fiedler et al., 2024). The dominant negative understanding of collaboration, defined as avoiding collaboration or having concerns about forming partnerships, was confirmed in groups with such assumptions. These groups had progressively worse experiences related to both social and cognitive transactive interactions throughout the entire research process. Järvelä et al. (2023) concluded that when sufficient resistance was not shown against triggering events that hinder collaboration, students did not socially, emotionally, and mentally adapt to the groups, and these groups became vulnerable to potential learning losses. From this perspective, collaborative understandings are a common behavioral pattern that affects both social and cognitive transactive interaction processes.

It was concluded that there were qualitative differences in the social and emotional awareness or expression abilities of group members while collaborating on cognitive tasks related to critical thinking, with social inference skills standing out in particular. Social inference skills refer to the process of predicting the possible and simple causes of observed social behaviors, usually quickly or automatically (Becker et al., 2021), and this skill begins to develop at a very early age (Poulin-Dubois & Brosseau-Liard, 2016). The reasons for the use of social inference skills at different levels and their effects on students have been repeatedly examined by research in neuroscience, memory studies, and behavioral sciences (Ferreira & Adleman, 2020; Hawkins et al., 2023; Molden et al., 2006; Nelson et al., 2005). Nelson et al. (2005), who examined the neuroscientific origins of this process based on social information processing theory, suggest that the social inference process occurs in three nodes in the brain. In the detection node, the characteristics of social stimuli, such as facial expressions or emotional cues, are analyzed; in the affective node, the emotional significance of the social stimuli is determined by activities in the amygdala, ventral striatum, and other parts of the limbic system, with emotional meanings assigned; and in the cognitive-regulatory node, social stimuli are subjected to higher levels of cognitive processing to interpret the mental states or intentions of others. Some memory studies have linked this process to emotional regulation habits and verbal memory (vocabulary) skills (Ferreira & Adleman, 2020). In other words, individuals who are better at re-evaluating the emotional state of a group member and performing verbal memory tasks tend to use their social inference skills more effectively. Some behavioral science studies also show that when individuals make appropriate social inferences, they make better decisions, which in turn improves group performance (Hawkins et al., 2023). Additionally, students' beliefs about their cognitive abilities also differentiate their social inference skills and their power to interpret these cues (Molden et al., 2006). Students who believe cognitive traits are fixed or unchangeable tend to think behaviors are reflections of stable personality traits, while those who believe these traits can develop focus more on the variable and situational causes of behavior. For instance, in a situation where a group member seems withdrawn and stressed, those who adopt the first approach tend to assume that peers already possess such characteristics. However, those who adopt the second approach are more likely to consider the possibility that their peer might be feeling pressured due to the social context and situational factors. These findings provide some explanations for communication-focused differences in groups when collaborating on cognitive tasks related to critical thinking.

The conclusion that students' perception of social well-being (their harmony within the group, satisfaction derived from spending time or working together, and friendship relationships) is determinant for transactive interactions, which are socially characterized, has also been identified in various studies (Crick & Dodge, 1994; Gross & Medina-DeVilliers, 2020). Many studies in this area show that an increase in the perception of social well-being enhances students' collaborative and participatory behaviors, while a decline in this perception increases behaviors associated with instability, such as dominance, conflict, jealousy, explosive reactions, and impulsivity, as well as social isolation behaviors like loneliness and withdrawal (Coie et al., 1982; Garrison et al., 2010; Onrubia & Engel, 2012). Hackman and Morris (1975) examined students' collaboration understanding and their level of harmony with each other in productivity, discussion, and problem-solving tasks, and found positive significant relationships ranging from .59 to .68 across three different types of tasks. A series of studies conducted by Lai, Sung et al. and (2011) Lai, Jong et al. (2011) demonstrated that when the perception of social well-being is insufficient, the effect of collaborative learning is diminished. However, some studies focusing on why perceptions of social well-being differ for groups suggest that this may relate to students perceiving cognitive tasks as competitive and being more likely to view peers they do not define as friends as competitors (Johnson et al., 1994; Liao et al., 2018). When examining the dialogues or statements of certain groups (e.g., G3, G7) that often depict a negative picture in terms of social well-being, it seems possible that students in these groups might have seen each other as rivals rather than establishing friendships or developing intimate relationships. On the other hand, there are also counter-evidence findings that contradict these conclusions (Klang et al., 2020; Senior & Howard, 2014). For instance, in a study conducted by Klang et al. (2020) with 958 fifth-grade students over 15 weeks, it was concluded that students' perceptions of the classroom atmosphere and their friendship relationships were not sufficiently significant in determining their motivation during the collaborative learning process. These results generally support the dimensions of social well-being related to self-esteem, group self-discipline, and internal state experiences, but emphasize that the aspect of friendship relationships may not always make a difference in transactive interactions.

In goal-oriented groups, students exerted significant effort to adequately complete the cognitive tasks presented to them. However, students in groups that deviated from the goal orientation were unable to do so sufficiently and generally focused more on performance goals rather than learning goals. These differences in goal orientation directly influenced the perseverance and determination behaviors of the groups. Some findings in this regard are supported by various mindset theories. For example, the data obtained from Groups 1, 2, 4, and 5 are similar to Gollwitzer’s model of action phases (Fujita et al., 2007; Gollwitzer, 1990). The goal orientations of these groups align with the deliberative and implemental mindsets in the model. Deliberative mindsets are superior in goal-setting, while implemental mindsets are superior in the effort demonstrated to achieve the goal (Brandstätter et al., 2015). These groups seemed to be a combination of both mindsets. On the other hand, the data from Groups 3, 6, and 7 were distinctly compatible with certain achievement motivation theories (Hokoda et al., 1989; Sorrenti et al., 2018). In relation to this, the regulation of thought production processes was also closely connected. This is often discussed in the literature on collaborative learning as group processing (Deutsch, 1949; Johnson et al., 2007) and organizational interactions (Hernández-Sellés et al., 2020). The ability of group members to monitor their progress toward their goals during collaboration—i.e., their group-based metacognitive abilities—had a significant impact on group performance (Haataja et al., 2022; Yager et al., 1985). When Yager et al. (1985) studied 84 third-grade students in terms of group metacognition, they found that groups who monitored their work or thinking processes achieved better results in academic success, knowledge retention, and transfer. Similar results have also been identified in other studies (Lachowsky & Murray, 2021). In this study, groups that were more successful in monitoring their thought production processes were typically the groups that engaged in more metacognitive conversations (metatalk) (Newman, 2017), exchanged better ideas and arguments in cognitive tasks, and made efforts to produce higher-quality arguments.

The most significant outcomes of cognitive-characterized transactive interactions were related to the exchange of knowledge, ideas, and arguments. Children can begin using such cognitive features to provide justifications for their decisions from around the age of 3 to 5 (Köymen et al., 2020). In collaborative-based cognitive tasks, students should engage in the exchange of knowledge, ideas, and arguments to explore the underlying mechanisms of the cognitive tasks presented to them. This enables group members to engage critically but constructively with each other's ideas (Howe et al., 1990; Mercer et al., 1999). Piagetian and Vygotskian approaches, in particular, have repeatedly argued that higher-order mental processes emerge in learning environments through such interactions (Piaget, 1952; Vygotsky, 1962, 1978). The common feature of these approaches is that individuals' opposing views and different levels of understanding stimulate social and cognitive conflicts, which in turn pave the way for more efficient cognitive processes. In this study, groups that interacted more frequently on issues related to the exchange of knowledge, ideas, and arguments generally provided more accurate answers to questions involved in cognitive tasks by striving to develop higher-quality arguments. This is explored in a broad literature focusing on the structure of cognitive tasks and teacher or researcher support (Gätje & Jurkowski, 2021; Liu & Tsai, 2008; Nemeth et al., 2023; Ouyang et al., 2023). Ouyang et al. (2023) examined the guiding elements of the processes of knowledge, idea, and argument exchange in collaborative group work. After analyzing 6,104 statements based on idea exchanges, they identified 13 different types of discourse moves that guided this process. These strategies were related to groups starting their negotiation process from the right point, staying within the negotiation through transition statements that guided each other, asking appropriate questions, and providing clear summaries before the decision-making process. Felton et al. (2015) more clearly outlined many of these details. In a study with 70 middle school students in Spain, they examined the structure of dialogues in the process of exchanging knowledge, ideas, and arguments, their approaches to arguments, and most importantly, how they responded to opposing views. When the students assigned to two groups under the conditions of agreement and persuasion were examined, it was found that students in the agreement group engaged more frequently in dialogues aimed at understanding, elaborating, and relating different perspectives to their own thinking. Students in the persuasion condition, on the other hand, spoke less when confronted with opposing views and engaged in dialogues aimed at ending the discussion. Although this contradicts Piagetian and Vygotskian approaches in certain aspects, the results of this study largely align with these findings. However, there are various studies that do not support these results (Sperber & Mercier, 2012).

In light of these results and the comprehensive discussion framework, several recommendations are made to strengthen the theoretical and practical structure of similar future research. First, students' collaborative tendencies in collaboration-based critical thinking processes should be taken into account. These different tendencies among students determine the direction in which higher-order cognitive tasks, such as critical thinking, will progress. Second, the importance of interactions among group members should be emphasized, and external support mechanisms should be prepared for situations where transactive interactions are assumed to be unsustainable. During implementations, actions should be taken accordingly. Third, the importance of social harmony in this process should be considered, and more effective groups should be formed using sociometric techniques. Finally, although the success of cognitive tasks may vary depending on their purpose and content, to increase the success of cognitive tasks and achieve more meaningful results, the focus should be on students' reading and comprehension skills rather than their academic achievements or previous standardized test scores. In this regard, educational systems and practitioners should recognize the significance of transactive interactions in collaboration-based learning environments and should not overlook the development of strategies in this area.

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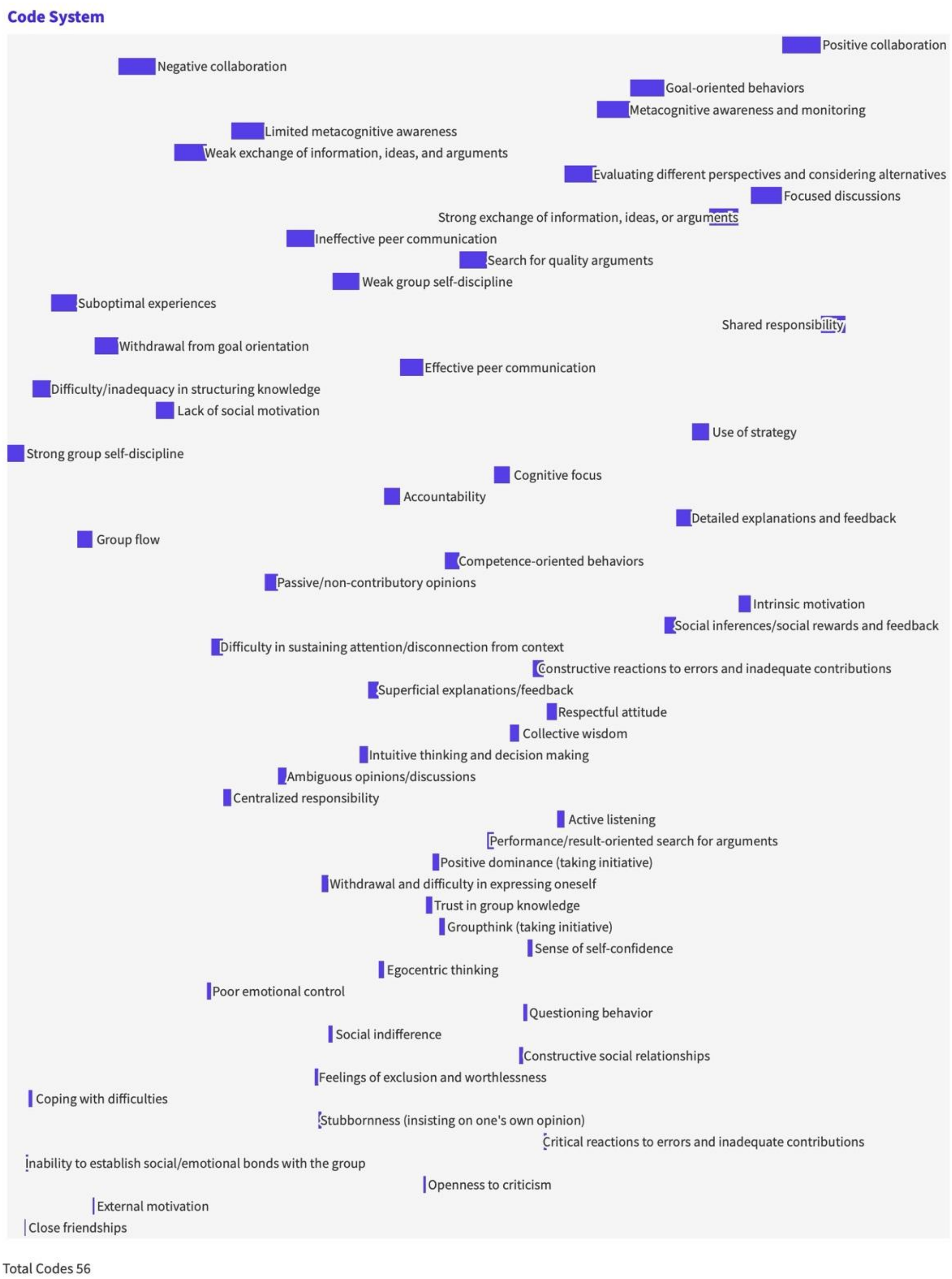
# Appendices

**Appendix 1.** A Subset of Questions from the Instruments Along with Their Conceptual Descriptions

| Instruments | Questions | Descriptions |
|---|---|---|
| SA | "Which classmates would you prefer to study with? Please write the names of three classmates in order from the one you prefer the most to the one you prefer the least." | This dimension focuses on group dynamics. |
| PA | "This activity went well for me in some ways because..." | This dimension relates to general individual experiences. |
| PeA | "How did your group members approach collaboration with you (e.g., sharing knowledge, giving feedback, willingness to work together)? To help us better understand, could you describe a behavior or dialogue you remember related to this? What exactly happened?" "During the activities, group members presented various ideas and behaviors, and you interacted with them. Who do you think contributed the most to you or your group, and what were the most distinct features you noticed during your interactions with them?" "How did your group members approach collaboration with you (e.g., sharing knowledge, giving feedback, willingness to work together)? To help us better understand, could you describe a behavior or dialogue you remember related to this? What exactly happened?" "During the activities, group members presented various ideas and behaviors, and you interacted with them. Who do you think contributed the most to you or your group, and what were the most distinct features you noticed during your interactions with them?" | This dimension involves students' evaluations of their group members. |
| I | "Some groups managed to establish a rich and effective network of interaction during the activities, while others could not. Can you explain the possible reasons for this based on examples from your own group?" | This dimension addresses the reasons behind differences in transactive interactions among groups. |
| RO | "Do group members collaborate effectively?" "Which types of discussions are most encouraged or suppressed by group members?" "How are the knowledge, ideas, or arguments proposed by members accepted, rejected, or filtered by the group?" | This dimension relates both to confirming students' statements and interpreting the meaning of those statements. |




**Appendix 2.** Code System. Frequency distributions of the codes were taken into account. Colour intensities decrease from frequently encountered situations to less frequently encountered situations in interaction processes.