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Studies of Argumentative Episodes in Academic Learning

Estudios de episodios argumentativos en aprendizajes académicos

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ABSTRACT
In recent years, researchers in Educational Psychology have focused their attention on the study of argumentation, particularly in sociocognitive interaction contexts within formal educational settings. Argumentation is defined as a social, communicative, and cognitive practice linked to the context, where justifying viewpoints with reasons is required. In university education, argumentation is essential for students in all academic activities. The study analyzed dialogical argumentation during collaborative problem-solving tasks among first-year Engineering students. The results revealed a high level of sociocognitive conflict, simple reasoning, and prior knowledge referencing. The conclusion is that it is essential for the development of students' argumentative skills to design activities that encourage sociocognitive conflict, aiming to enable students to provide viewpoints that encompass multiple perspectives and thereby enhance their understanding of the studied phenomena.

KEYWORDS: argumentation, argumentative episodes, sociocognitive conflict, sociocognitive interaction, reasoning.

RESUMEN
En los últimos años, los investigadores en Psicología Educativa han centrado su atención en el estudio de la argumentación, especialmente en contextos de interacción sociocognitiva en entornos educativos formales. La argumentación se define como una práctica social, comunicativa y cognitiva vinculada al contexto, donde se requiere justificar puntos de vista con razones. En la educación universitaria, la argumentación es crucial para los estudiantes en todas las actividades académicas. El estudio analizó la argumentación dialógica durante la resolución colaborativa de tareas de física por estudiantes de primer año de Ingeniería. Los resultados mostraron un alto conflicto sociocognitivo, razonamiento simple y referencia a saber previo. Se concluye que es fundamental para el desarrollo de la capacidad argumentativa de los estudiantes el planteo de actividades que incentiven el conflicto sociocognitivo apuntando a lograr que el estudiante pueda ofrecer un punto de vista que abarque múltiples perspectivas y complejizando de esta manera su comprensión de los fenómenos en estudio.

PALABRAS CLAVE: argumentación, conflicto sociocognitivo, episodios argumentativos, interacción sociocognitiva, razonamiento.

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1. INTRODUCTION

In recent decades, the study of argumentation has emerged as a theoretically significant field, especially in the educational context, and more specifically within the realm of educational psychology. This approach has become a central perspective in academic research, focusing on two essential dimensions: the analysis of argumentation that unfolds in interactive environments and the instruction of argumentative skills to university students. Despite the potential differences in approaches and methodologies within this domain, there is a consensus among scholars in understanding argumentation as a process intrinsically linked to reasoning, taking place within a dialogue characterized by the confrontation of ideas (Peralta et al., 2023).

This perspective, centered on the analysis of argumentation in interactive contexts, aims to understand how students use argumentation as a tool for building knowledge and expressing their ideas. Emphasizing the importance of investigating how students employ arguments in situations of debate, discussion, or classroom interaction, it becomes a crucial practice for learning and problem-solving.

As Leitão (2000) expresses, arguing involves the need to support and justify a point of view with solid reasons, transforminginto a dialectical process that encourages the clash of ideas and the search for consensus in argumentative discourse. This establishes dialogical argumentation as a favored method for resolving differences of opinion among students, which can manifest as the phenomenon known as socio-cognitive conflict.

Originating in the 1970s, the Socio-cognitive Conflict Theory was developed from empirical research focusing on the influence of social interactions on cognitive advancement. This theory postulates that socio-cognitive conflict emerges when individuals collaborating on a task possess conflicting perspectives about its solution (Doise & Mugny, 1984; Doise et al., 1975; Psaltis et al., 2009).

The conflict is cognitive when another individual presents a conflicting problem-solving model and can justify it. This can occur either through direct confrontation of differing viewpoints or by expressing doubts or questions regarding a solution proposed in collaborative tasks (Peralta, 2010). Additionally, the conflict is social because it stems from differing social responses (Gilly, 1988) and contributes to the social construction of new cognitive tools (Carugati and Mugny, 1988).

Two primary kinds of socio-cognitive conflict regulation are discerned: epistemic (socio-cognitive) and relational (social). While a relational regulation seeks to restore a non-conflict situation, theepistemic resolution involves coordination of centrations and the elaboration of new cognitive instruments, fostering cognitive development and emotional engagement (Peralta & Roselli, 2016).Cognitive advancement can range from the assimilation of existing knowledge to the creation of new meanings.Moreover, sociocognitive conflict also allows the individual to remain emotionally engaged and aware of alternative solutions to the same issue (Castellaro & Peralta, 2020; Perret-Clermont, 2022).

Returning to the subject of argumentation, Leitão (2000) highlights three essential components of argumentation that give it the power to resolve conflicts epistemically: the argument, counterargument, and response. The first element, the argument, presents a viewpoint supported or preceded by a justification, reflecting the speaker's current stance on the debated topic. Conversely, a counter-argument emerges to challenge, object to, or criticize the original proposition, highlighting alternative perspectives. This component is vital for maintaining the genuine dialogic essence of argumentation. Lastly, the response acts as a reaction to the counter-argument and is evaluative in nature, as it weighs the strength of the arguments against the presented objections.

Responses can range from complete rejection to integrative ones that seek to enrich the original stance by considering opposing views. Incorporating diverse voices into the argumentative discussion process enriches the primary argument and is linked to theepistemic resolution of socio-cognitive conflicts (Leitão, 2000; Stegmann et al., 2007).

Within this sphere, argumentation surfaces as a discursive process facilitating cognitive decentration, permitting individuals to assimilate diverse perspectives and immerse in dialogues to dissect them (Castellaro & Peralta, 2020). This makes argumentative dialogue the ideal setting for knowledge construction arising from socio-cognitive conflicts (Baker, 2009; Baker & Schwarz, 2019).

The ability to produce counterarguments has proven to demand a high level of cognitive work and is closely related to educational experiences (Larrain et al., 2020). This challenge is evident in multiple empirical pieces of evidence. Recent research has highlighted significant challenges university students face in seamlessly integrating arguments and counterarguments into their discussions. They tend to maintain their viewpoint without revising it based on counterarguments and often fail to integrate diverse perspectives (Peralta et al., 2019).

On the other hand, adding evidence to this line of thought, the study by Cano et al. (2019), focused on analyzing the argumentative structure of university students' discussions, found a high frequency of arguments and a low frequency of counterarguments, with fewer refutations. Additionally, the most common argumentative strategies in counterarguments were changing the focus, followed by "Partially Agree (PA)" and to a lesser extent "Irrelevant Arguments (AI)" and "Questioning Reasons (QT)".

If the elaboration of counterarguments and their relationship with arguments is challenging for students, the anticipation of counterarguments, which can also be regarded as a sophisticated argumentative strategy, poses challenges to students across various disciplines (Amaral & Leitão, 2019). This is also true for the integrations of arguments and counterarguments and the inclusion of diverse voices in discourse. In the aforementioned study by Cano et al. (2019), when faced with opposition from an interlocutor, the most common response was to dismiss it. In this context, Gronostay (2016) found that while students could effectively present counterarguments to their counterparts, very few were capable of appropriately assimilating criticism into their discourse.

In discussing the challenges of integrating diverse voices, Tuzinkievicz (2020) noted that university students, particularly newcomers, exhibited a confirmatory bias when presenting opposing information in their arguments. This bias was influenced by the format of the information, with newcomers showing greater susceptibility to graphical data.

However, these findings contrast with those of Garcia-Mila et al. (2013), who showed that when students aim to reach a consensus, they produce complex argumentative structures, especially those involving two-sided reasoning. In discussions where the goal is consensus rather than persuasion, students produced a greater number of refutations, implying they were more willing to consider both sides of an argument and recognize the limitations of their own claims. Conversely, Butera et al. (2018) posited that individuals, when perceiving their competence as threatened — especially in competitive contexts — tend to seek or interpret evidence aligning with their preconceived notions. These authors view this behavior not merely as a cognitive misstep but as a deliberate strategy in response to specific social and motivational situations.

In this setting, Liu et al. (2019) broad understanding of how students approach and structure their arguments in different contexts and goals. Their analysis revealed that discussions on descriptive or non-theoretical topics did not have a high presence of

opposition. However, for theoretical topics, students were found to construct criticisms, using refutations backed by personal experiences or scientific information. The analysis also indicated that students' prior scientific knowledge influenced their argumentation only in descriptive topics, and the collaborative environment was more critical than prior knowledge in constructing evidence-based arguments on theoretical topics. In this sense, it could be proposed that student´s prior scientific knowledge, specifically the similarity or dissimilarity between partners, influences the argumentation process (Castellaro et al., 2021). Consequently, argumentation, as an interactive process, might show variations based on the simmetry or assimetry between individual perspectives or competences (Asterhan et al., 2014). Within this framework, the aim of the article is to analyze the process of dialogic argumentation during the collaborative resolution of physics tasks in first-year Engineering student dyads at the university. Additionally, this process was assessed in relation to the cognitive symmetry/asymmetry between the partners´s individual perspectives.

2. MATERIALS AND METHODS

The *sample* consisted of 24 first-year university students in a natural science program. They were randomly organized into 12 pairs. The average age of the students was 18 years.

To control for this condition, pre-test questionnaires were created to assess the participants' prior knowledge. In this specific case, the topic was relative motion, and the material provided was a text presenting a fictitious dialogue about everyday physical phenomena related to the concept of motion. The text was followed by a series of activities that required more than just reading comprehension, as they involved conceptual development (e.g., providing their own examples).

The purpose of the pretest was to evaluate the participants' conceptualization regarding the concept of relative motion. This pretest consisted of an exercise comprising three questions related to the topic, designed to identify three levels of knowledge: the initial level (one correct answer), the intermediate level (two correct answers), and the advanced level (three correct answers). Then, each pair was instructed to collaboratively study and learn the material and to complete the designated activities freely within a 90-minute timeframe. All sessions were audio-recorded for subsequent analysis.

For the *data analysis*, the following procedure was followed: all interactions were transcribed, and within them, argumentative episodes were identified. An argumentative episode is recognized when a participant makes a reasoned verbalization (or several)

that either presents **a proposition conflicting with the alter's position** or **responds to a question from the alter**. Once argumentative episodes were identified, they were categorized based on:

- Trigger: the situation that led to the episode, which could be a a conflict between perspectives (when participants have different viewpoints on task resolution) or a question (a broader sociocognitive conflict, where one participant, through a question, expands options and thinking for their partner) (Castellaro et al., 2020, Peralta et al., 2023).
- Argumentative strategy (Cano, Castelló & Leitao, 2019): the way of responding to the opposing position or question, which could be partially in agreement (a counter-argument considering that a position, either one's own or another's, allows for nuances and partial agreements), changing the focus (a counter-argument used to shift the discussion's direction, either by denying what was said or providing a contradictory opinion), or irrelevant (a counter-argument used to challenge the alternate position with irrelevant or inconsistent claims).
- Reasoning based on: simple statements (typically propositions based on prior knowledge) or consequential (based on the consequences of a statement) (Cano & Castelló, 2016).
- Reference to different voices: referencing the text, prior knowledge, hypothetical examples, the voices of other peers, and personal experiences.

3. RESULTS

A total of 84 argumentative episodes were detected, which are fragments of dialogues in which a participant makes a verbal expression supported by a proposition that conflicts with the other participant's position or provides a response to a question posed by the latter.

These episodes, for the most part (62%), were triggered by conflict situations, while the remaining 38% were triggered by a question. Below are examples of both cases:

Sociocognitive conflict	Question (extended sociocognitive conflict)
– *...it's moving in relation to us, it gets closer and the distance gets shorter* – *depending on where you're looking from... if you're looking at it perpendicular to the center of the windshield, it doesn't move...* – *it does move...*	– *The speed is from a specific point.* – *And why is the velocity the same?* – *Because velocity is in relation to a point, from one point to another...* – *And can't you measure speed from one point to another?*

– *perpendicular to the center, from the axis of the windshield, it doesn't move... because it makes a semicircle...* – *yeah but it doesn't make a semicircle, look...* – *well, but it's like the curvature of the windshield* – *there's barely any curvature... but okay.*	– *Yes, but... you can say that at that point the car was going 100 and the velocity at this point.* – *Alright.*

Regarding the argumentative strategy used by the participants in the argumentative episodes, it was observed that the most commonly used strategy (69%) was "changing the focus." This strategy involves using a counter-argument to redirect the discussion, either by negating what was previously expressed or by presenting an opposing opinion. To a lesser extent (31%), participants employed the strategy of "partially agreeing," meaning they used a counter-argument that considers that a position, whether their own or someone else has, allows for nuances and partial agreements. No irrelevant argumentative strategies were detected.

the type of reasoning used, it's noteworthy that in 69% of the cases, "simple assertions" were employed. This means that reasoning was based on propositions derived from prior knowledge. In this approach, participants began with premises or assertions previously established as true and used this foundation to arrive at a logical conclusion or inference. It's a reasoning process grounded in existing information, allowing for the coherent and well-founded connection of ideas.

In contrast, the remaining 31% of the episodes were characterized by the use of "consequential reasoning." In this case, reasoning was built upon the consequences derived from a given assertion or premise. The exploration focused on how a given assertion leads to a series of logical outcomes or implications.

In connection with the use of "external voices" in the argumentative episodes, it was noted that 46% made reference to prior knowledge in their arguments, 30% referenced a specific text or book, and 24% used hypothetical examples. No references to the voices of other peers or personal experiences were detected.

Finally, an analysis of the participants' pretest results was conducted, revealing that half of the dyads consisted of individuals with different levels of conceptualization (initial-intermediate/initial-advanced/intermediate-advanced), while the other half had individuals with identical levels of conceptualization (initial-initial/intermediate-intermediate/advanced-advanced). This information was examined in the context of triggers, and it was observed that in dyads with the same level of conceptualization, the primary trigger was sociocognitive conflict, while in dyads with different levels of conceptualization; the most commonly present trigger was a question.

4. DISCUSSION AND CONCLUSION

The results of this study unveil intriguing aspects regarding the dynamics of argumentative episodes. Firstly, a total of 84 argumentative episodes were identified where participants backed their statements with propositions that conflicted with the position of another participant or provided answers to posed questions. A significant discovery was the influence of triggers in generating argumentative episodes. In most instances, socio-cognitive conflicts acted as triggers, suggesting that differences of opinion and divergent viewpoints play a fundamental role in sparking debates. These confrontations can present valuable opportunities for learning and joint knowledge construction.

Furthermore, the remaining 38% of the episodes originated from questions raised during the interaction, indicating that questions serve as a starting point for constructing arguments and exploring subjects.

Regarding argumentative strategies, participants mainly employed two approaches. The predominant one was the "shift in focus" strategy, where they frequently sought to redirect the discussion by either negating a previously expressed point or presenting opposing views. In a lesser proportion, the strategy of "partially agreeing" was used, reflecting an inclination to recognize nuances and partial agreements in positions. These findings align with those observed by Cano et al. (2019), who found that most students, aiming for consensus, opted to shift the focus of the discussion, confirming the challenges students face in effectively integrating arguments and counterarguments in their discussions (Gronostay, 2016).

In line with findings by Cano et al. (2019), this could reflect a general student tendency to avoid direct confrontation in discussions, instead favoring more conciliatory strategies. However, contrasting with the findings reported in the said work, this research detected no presence of "irrelevant" counterarguments.

Regarding the type of reasoning employed, the majority of episodes relied on "simple statements," indicating participants based their arguments on propositions drawn from prior knowledge, suggesting a logical approach grounded in existing information.

Concerning the use of "other voices" within argumentative episodes, a wide variety of reference sources were observed that participants used to support their arguments. One of the primary sources was "prior knowledge", implying participants referred to previously acquired information or knowledge. This aspect underscores the significance of the speakers' experience and prior knowledge, which contribute to

constructing their arguments. Usage of prior knowledge was evident in nearly half the cases, highlighting the importance of prior knowledge in the argumentative process.

A considerable percentage of participants supported their arguments referencing "specific texts or books," underscoring the influence of literature and research as foundations for their claims. Citing specific texts brings an academic and objective dimension to the discussion, potentially enhancing dialogue quality. Additionally, participants utilized "hypothetical examples" to support their arguments. These imaginary examples acted as illustrations to clarify and back their viewpoints. Hypothetical examples can simplify complex concepts and facilitate understanding.

An interesting discovery was the "lack of references to the voices of other colleagues or personal experiences." In these argumentative episodes, no mentions of other colleagues' perspectives or personal anecdotes were detected. This might suggest participants leaned on more objective and fact-based sources rather than drawing from personal experiences or their interlocutors' perspectives.

Consistent with the study by Liu et al. (2019), participants in this study, discussing theoretical topics, could construct and respond to criticism, backing their contributions with various types, primarily objective, evidence. This might have been facilitated by the collaborative environment in which the students worked.

In the final stage of the analysis, the results of the pretests conducted by the participants were additionally examined. This revealed an equal division among the dyads into two categories: in half of them, the subjects exhibited similarity in their levels of conceptualization regarding the concept of relative motion; the other half consisted of subjects with different levels of conceptualization, meaning that one displayed an initial level of conceptualization, while the other exhibited an intermediate or advanced level.

The primary finding was that there is a relationship between the composition of the dyad (equal or different levels of conceptualization) and the primary trigger of argumentative episodes. This additional finding was crucial for understanding how argumentative episodes were triggered in dyads. In dyads with the same level of conceptualization, the primary trigger that propelled argumentative episodes was sociocognitive conflict in the strict sense, meaning situations where the subjects' partial ideas confronted each other. This dynamic suggests that when participants start from a similar level of conceptualization, discrepancies in their viewpoints generate conflicts that lead to enriching argumentative debates. From a conceptual perspective, this finding aligns with the paradigmatic situation of sociocognitive conflict theory, which highlights equality in the level of conceptualization as a fundamental condition for the production of

sustained and epistemically resolved debates (argumentation) rather than relational ones (Butera et al., 2019; Perret Clermont et al., 2015).

On the other hand, in the case of asymmetrical dyads, the most predominant trigger for argumentation was the question. This pattern suggests that in situations where one of the participants possesses a more solid or advanced initial knowledge, curiosity and the need to gain clarity on the subject matter drive the generation of questions as a starting point for discussion. Ultimately, it is possible to consider that in asymmetrical dyads, the argumentative dynamics could be likened to a tutoring effect, where the question plays an essential role in leveling knowledge and facilitating constructive dialogue. This finding implies, on a conceptual level, an expansion of the idea of sociocognitive conflict because it does not arise from the confrontation of perspectives but from the imbalances that questions or inquiries from the more advanced individual can create when directed at the person with a lower level of conceptualization (Asterhan et al., 2014; Castellaro et al., 2023). This represents a point of theoretical integration between perspectives identified with a Piagetian and Vygotskian approach.

In conclusion, it is emphasized the importance of recognizing and valuing the impact of the university experience on the development of students' argumentative skills. It is crucial to design activities and projects that promote continuous practice of argumentation throughout their academic formation. Furthermore, it is essential to provide opportunities to enrich students' vocabulary and cultivate a more versatile and open approach to argumentation.

It is relevant to highlight that the type of task plays a crucial role in the ability to argue. Therefore, it is recommended to create diverse tasks that address a wide range of topics and motivations, taking into account students' familiarity with the subjects and how this affects their argumentative competence.

Finally, it is important to underline that argumentation is presented as a more productive mode of resolving intersubjective differences compared to other methods based on imposition or social compliance. Consequently, promoting the argumentative approach and constructive dialogue becomes a crucial imperative in the university context.

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