A.Toulmin's argumentation pattern

A model of argumentation that has been increasingly used in Science Education is Toulmin's argumentation pattern [2]. This model identifies the basic components of an argument as claim, grounds, warrants and backing; qualifiers and rebuttals are identified as additional elements in complex arguments. For further detail in these elements refer to Driver et al. [2]. Although these elements serve the purpose of identifying an argument, they fail to assess the veracity of the conclusions [2]. Therefore, learning through argumentation also needs to take into account social factors, such as context and interactions, and to qualitatively analyze the discussions performed by a group of people.

B.Peer instruction

PI refers to the education technique introduced by Mazur in which students interact to solve a conceptual question [9]. The instructor presents a multiple choice question to the students, who choose their answer individually and vote anonymously. The instructor then asks the students to find someone whose answer was different from theirs and to convince that person of their answer. After peer discussion, the poll is reopened and students vote for a second time; the instructor then gives a conclusion reassuring their knowledge. For further detail about this learning strategy refer to Mazur [9].

Discussions during PI have been largely studied in traditional environments, mainly in the context of Mechanics. Crouch and Mazur proved that PI promotes conceptual reasoning and problem solving abilities in introductory physics courses [5]. Wood, Galloway, Hardy and Sinclair studied students' discussions, which revealed that students use three types of resources linked to reasoning within their dialogues: previous knowledge, relations between knowledge elements, and control structure [6].

C.Tutorial-like activities

Tutorial-like activities are worksheets created by the instructor with the objective of guiding the student step by step on the construction of new concepts, they are strongly based on model problem solving, and sometimes resolve a cognitive conflict; these worksheets are inspired on Tutorials for Introductory Physics [7]. Each activity has a specific objective for which questions are made at the beginning with an introductory approach, and new concepts are incorporated at an adequate pace.

Even though these activities are answered in writing, they require an oral discussion for students to reach a consensus. Students work collaboratively, exchanging ideas and reasoning that lead to the answer of the question in turn. The instructor supervises students' performance by asking them questions to make sure they are working on the right direction; the instructor also asks key questions to lead them into the objective of the activity. Once most teams have completed the activity, the instructor gives closure by reviewing the concepts, reassuring learning.

D.Student centered learning environment

SCALE-UP environments are designed to naturally promote discussion, making it adequate for active learning strategies when argumentation is essential. The SCALE-UP environment has been set up in Mexico in a private university in the northern part of the country, and is known as Student Centered Learning room (ACE room for its acronym in Spanish). Besides being a SCALE-UP environment, the ACE room has a research table that is equipped with three video cameras and three microphones that allow the researcher to record the interactions that happen on each team of that table [10].

Considering the reviewed literature, when using these two learning strategies in a SCALE-UP environment, the hypothesis is that either of the following behaviors is expected: (1) students' discussions have a similar dynamic around the learning community on both strategies, or (2) students create a different discussion dynamic during PI than that during Tutorial-like activities. Based on this hypothesis, the following research question is formulated: How are the interactions that take place during active learning activities, such as PI and Tutorial-like activities, in a SCALE-UP environment?

III. METHODOLOGY

Participants. The participants were nine undergraduate students enrolled in an Electricity and Magnetism (EM) course taking place in the ACE room of the university. The setting was three teams of three students each around one table of the room. The teams were formed based on their performance on the first midterm evaluation of the course by combining one average student, one above-average student and one below-average student, without considering the students located on the extremes, who performed best and worst on the evaluation. The students located on the extremes were seated at other tables in the classroom and were not considered in this study.

Figure 1 represents the distribution of participants sitting around the table, which was consistent throughout the duration of the study. To respect the confidentiality of the participants, we used labels to identify them: capital letters correspond to the team and small caps represent their physical place around the table; thus the participant from team *A* sitting on chair *a* is labeled as *Aa*. These labels are used throughout the text and are independent of students' performance.