

## Epistemic Agency in Physics within SCALE-UP: Development of the Classroom Observation Protocol for Epistemic Agency (COPEA)

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# Introduction

## Abstract

In this qualitative case study, we document instances in which students display epistemic agency in an introductory physics course within the student-centered active learning environment for undergraduate programs (SCALE-UP) [1] of a large research university southeastern USA. We report on the development of an observational tool, the Classroom Observation Protocol for Epistemic Agency (COPEA). The COPEA promises to be useful in future studies of how the instructional approach represented in SCALE-UP facilitates students' epistemic agency, which we argue is key for proficiency in science. The occurrence and levels of students' epistemic agency was found to vary across groups.

## Conceptual Framework

The goal of science teaching and learning is for students to develop proficiency in science by engaging in the practices of science, learning core ideas and crosscutting concepts in the service of sense making about the natural world [2]. This three-part goal highlights the need for students to know more than information. They need to be able to know the subject-matter or content, in ways that allow them to model physical phenomena, negotiate concepts in argumentation, and be able to understand and explain phenomena i.e. 3-dimensional learning [3]. This ability to use knowledge in the service of sense making is referred to as science proficiency. The development of science proficiency requires that students be active epistemic agents – that is they need to be active players in the construction of knowledge, taking responsibility for “shaping the knowledge and practice of the community [4] of science. Here, the community is the science classroom. This means that students own and participate in the process of knowledge construction. They ask deep questions to themselves and their peers in order to clarify understanding, argue from evidence, and present their ideas for constructive criticism. In these ways, they exercise epistemic agency.

Epistemic agency refers to the capacity, condition or state of action that is expressed by “individuals or groups who take or are granted responsibility for shaping the knowledge and practice of the community” [4]. Epistemic agency is vital for participation in knowledge-construction within small group discourses such as during “students’ learning of science-as-practice as they act as epistemic agents” [5]. Epistemic agency is not fostered when learners are treated as passive recipients of information in a classroom in which the teacher is a sole-knowledge-authority. Rather, to foster epistemic agency, students take or granted responsibility for shaping the knowledge and practice of the classroom community [6].

## Statement of the Problem

Given the salience of epistemic agency to the development of science proficiency, clearly, this construct requires far more research. But, how might we characterize observations focused on learners' epistemic agency? There is the challenge of limited methods for collection of data and analytical tools for studies of this construct [6].

## Method

## Research Design



### Picture of the SCALE-UP in session

[illegible]

## Participants

The participants for our field test of the COPEA were 5 females and 4 males, undergraduate students enrolled in a college in the south east. Three of the females were also in the teacher preparation program as a double major. The students came from diverse majors including computer science, mathematics, engineering, and physics. Some of them took physics in high school and others did not. We briefly described the purpose of our pilot study to them, explaining the construct using the idea of ownership of their learning experience. It was a freshman classical mechanics course designed as SCALE-UP.

## Data Collection

The first author and the second author (an undergraduate physics major) were involved in a participant observation, sitting through the freshman classical mechanics physics classes for a period of at least four consecutive weeks both in the Summer and Fall of 2017. We took observation notes and video recorded the group of students.

## Analysis

In our data analysis, we focused on the interaction among the students, between the student(s) and the instructor or teaching assistant whenever the latter came around the small groups. We paid attention to the students verbal exchanges and expressions of gestures within and across groups during such moments and evaluated the intensity of their discourses using the COPEA's scales numbered 1 to 4 i.e. 1 means that the marker is not observed, 2 means that the observed marker was not a focus for student discourse, 3 means the observed marker is an intense focus for at least a member of the group, and 4 means that the observed marker is an intense focus for the entire members of a group

## Results

**We compared across groups in an energy conservation session and found that there were variations in epistemic agency within and across students and groups.**

**In a related consideration, student epistemic agency varied from lesson to lesson.**

Also, certain markers of epistemic agency manifested during some class sessions or moments than others, depending on whether the course work for that day was focused on whiteboard activity (targeted at conceptual understanding) or lab work designed as guided inquiry

**They also struggled with and discussed uncertainties in their work.**

## Discussion

The quality of interaction in small group discourses is very important for student exercise of epistemic agency. The quality of interaction is evaluated as collaborative in nature or more directed and taken-over by a member of the group. Thus, moments of epistemic agency in groups that were less collaborative (more of the latter) were not intensively inclusive for all members of the group compared to a more collaborative group. Students would need more support and scaffolding of their efforts during both components (whiteboard and lab activities) of the SCALE-UP course design. The design of the lab tasks might need to be reviewed to foster richer discourses and sense-making among students so as not to be frustrated beyond a level that is productive. There may be the need to evaluate how well integrated the white board activities and the labs are. The goal is to improve opportunities for richer discourses.

## Conclusion/Limitation

**We conclude that, the COPEA is suitable and promising for qualitative study of learner epistemic agency in small group discourses. However,**

larger discourse groups such as group of 5-10 and more participants or students may require an adaptation of the scale.

## References

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**American Association of Physics Teachers (AAPT)**  
**Winter Conference, San Diego (CA), January, 2018**