

# The Role of Uncertainty in Social Regulation of Learning

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**Abstract:** We explored how three groups of pre-service science teachers regulated their learning through a series of collaborative inquiry tasks of varying uncertainty levels. We also measured individual students' views on uncertainty, and created groups with similar and mixed views. We found differences in groups' regulation of learning. The uncertainty-oriented group engaged in socially-shared regulated learning more than the other two groups, actively pursuing resolution of their uncertainty. We discuss the implications for science educators.

**Keywords:** Social regulation of learning, uncertainty, science education, pre-service teachers

## Introduction

In this qualitative study, we drew on social psychology, regulation of learning, and science education literatures to illuminate how groups of pre-service science teachers of different uncertainty orientations socially regulate their learning through five collaborative inquiry tasks of varying levels of uncertainty. To navigate complex issues in today's information-based society, citizens need robust scientific and technological literacy as well as a broad range of competencies that include collaboration, communication, critical thinking, and creativity (National Education Association, n.d.). However, learners in collaborative groups encounter various challenges (e.g., motivational, socio-emotional, cognitive, etc.) as they work toward their personal and group learning goals (Järvelä, Järvenoja, Malmberg, & Hadwin, 2013). Overcoming these challenges requires that group members effectively plan, monitor, control, and evaluate their learning, which is called social regulation of learning (Hadwin, Järvelä, & Miller, 2018). Researchers have emphasized that regulation is socially situated and combines individual and social processes (Hadwin et al., 2018). Learners' success at social regulation is likely affected by how well they can manage the uncertainty inherent to scientific inquiry.

People vary in how they deal with uncertainty (Sorrentino & Roney, 2000). Uncertainty-oriented (UO) individuals tend to approach uncertainty, engage in active exploration, and think deeply to resolve it. In contrast, certainty-oriented (CO) people focus on retaining certainty and clarity of their present worldview, and strive to avoid uncertainty, seeking out situations that do not raise ambiguity (Sorrentino & Roney, 2000). Thus, it is reasonable to expect that group members of different uncertainty orientations engaged in collaborative science inquiry will experience and deal with uncertainty in different ways. In turn, such differences may contribute to the challenges that necessitate groups' engagement in social regulation of learning. Thus far, researchers have investigated general challenges small groups experience, their subsequent adaptive responses, and the emergence of regulation of learning (Hadwin et al., 2018). However, less is known about how group members' individual differences might shape social regulation of learning. We aimed to contribute to the knowledge on social regulation of learning through a study framed by the following research question:

*How does regulation of learning during small group collaborative inquiry in science differ for people of different uncertainty orientations through a series of tasks of varying uncertainty levels?*

## Methods

Our study was carried out in a large, public university in the southeastern United States. Participants were 18 pre-service elementary science teachers enrolled in a science methods course. The majority of participants were Caucasian (83%) and female (94%).

First, we group administered two uncertainty orientation instruments (Sorrentino, Roney, & Hanna, 1992). The first instrument, termed the nUncertainty, measures a person's need to resolve uncertainty. The second instrument, a measure of authoritarianism, captures a person's need to uphold their certain views (Sorrentino et al., 1992). Scores from both measures were used to determine the resultant uncertainty orientation score and determine whether someone is UO, CO, or in the middle. Based on their uncertainty orientation scores, we assigned participants into 4-person collaborative groups. We selected three small groups made up of UO, CO, and mixed uncertainty orientation participants (i.e., one UO, one CO, and two moderates). We video recorded those three groups as they engaged in a baseline collaborative task followed by a series of five inquiry tasks of varying levels of uncertainty over the course of the semester. Video data is the primary data source for this study, but we also collected observational field notes, artifacts of group work, and students' individual reflective blogs to enable

data triangulation. For our preliminary data analysis for this poster, we employed video analysis according to the guidelines for research in the learning sciences (Derry et al., 2010). We watched videos of each of the three groups and wrote analytic memos about each group's sessions, logging time stamps with observed modes, processes, and strategies of social regulation of learning. We partially transcribed interesting episodes. We discussed our observations and how the regulation of learning differed due person's uncertainty orientations.

## Results and discussion

Our preliminary findings showed differences in modes, processes, and strategies of social regulation of learning between the three groups. Across tasks, UO group engaged mostly in socially-shared regulation of learning (SSRL), meaning that group members' contributions were collaborative, and often followed by uptake and additional contributions of at least one other person. The group members occasionally used co-regulated learning (co-RL), to temporarily guide regulation of others in the group, and self-regulated learning (SRL) to monitor and control their own learning. In the high uncertainty tasks, the UO group relied on sustained planning and monitoring, jointly building their task understanding and sharing their knowledge. Their evaluations of progress and quality of work were frequent and positive. In the low uncertainty task, they pursued novel solutions, enjoying the inquiry process. If a group member expressed doubts and confusion, others helped resolve it. They rarely asked for help from the instructor. The group was characterized by a positive group climate and group members often used humor as a strategy to nurture it.

In contrast, the CO group engaged in more instances of SRL than co-RL or SSRL. Members often did not respond to the statements of others. They engaged in some task planning, but often took action independent of other members. In high uncertainty tasks, they relied on help seeking from the instructor as their main strategy. In low uncertainty tasks, they pursued obvious solutions. Their evaluations of the group's work were often negative. The group climate was neutral to positive, with no disrespectful interactions. The mixed uncertainty orientation group engaged mostly in SSRL and co-RL, but overall regulated their learning less than the UO group. In low uncertainty tasks, they engaged in more planning than in high uncertainty tasks, yet produced routine solutions. They engaged in fewer evaluations of their work and progress than the other two groups. Help seeking was not as prominent as in the CO group. The group's climate was positive and they used the telling of personal stories to nurture it. Hence, small groups of different uncertainty orientations regulated their learning in different ways. Our findings have implications for science educators fostering collaborative inquiry practices. Groups differ in the type of support that might be most beneficial for helping them reach the intended learning goals. Explicit discussions about uncertainty as an unavoidable part of science and strategies the groups can use to draw on members' strengths could help students who are struggling to take a more active and creative approach.

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