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RESEARCH ARTICLE

Students' recognition of educational demands in the context of a socioscientific issues curriculum

Mats G. Lindahl1 | Anne-Mari Folkesson2 | Dana L. Zeidler3

1Department of Chemistry and Biomedical Sciences, Linnaeus University, Kalmar, Sweden
2Department of Education and Teachers' Practice, Linnaeus University, Kalmar, Sweden
3College of Education, Department of Teaching and Learning, University of South Florida, Tampa, Florida

Correspondence
Mats G. Lindahl, Department of Chemistry and Biomedical Sciences, Linnaeus University, 39182 Kalmar, Sweden.
Email: mats.lindahl@lnu.se

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Abstract
Students' difficulties in interpreting what counts as knowledge have been addressed in past research on science education. The implementation of progressivist pedagogy in terms of more student-active classroom practice and the introduction of a variety of discourses into the science classroom deepens students' difficulties. The integration of different forms and demands of knowledge and discourses typified by Science-in-Context initiatives, such as within the socioscientific framework, exemplifies this development in science education. Here, the diffuse boundaries between school subjects and other silos of knowledge lead to considerable difficulties for students to interpret what is expected from them. Such contexts having diffuse boundaries between, for example, subject discourses and other forms of knowledge, have been described as contexts with weak classification. The present study aims to explore students' interpretation of what knowledge or meaning they are requested to produce in contexts with weak classification, here exemplified within an SSI-task. We use Bernstein's concepts of recognition rules and classification to analyze how 15- to 16-year-old students develop their discussions in groups of 4–6 students. This study reports how students' recognition of the educational demands enabled integration of different discourses in their discussion, and that the use of both universalistic and particularistic meanings can produce new understandings. Students who had not acquired recognition rules were found to keep discourses apart, expressed either as rejection of the relevance of the task, answering questions as in a traditional school...
task, or just exchange of personal opinions. Furthermore, they included discourses irrelevant to the issue. An important outcome of the study was that socioscientific thinking was hampered when students kept universalistic and particularistic meanings apart. This hampering results from the inhibition of dynamic exploration during SSI discussions. The results provide new insights with relevance for teachers' guiding students toward a fruitful SSI-discourse.

KEYWORDS

critical thinking, discourse analysis, science literacy, socioscientific issues

1 | INTRODUCTION

In the last decades, the science classroom has changed from a place where students are the recipients of ready-made knowledge (Gaskell, 1992) to a place where they learn how to do science and use their knowledge to develop their reasoning skills (Berland et al., 2016; Zeidler, 2014). Accordingly, there has been less reliance on the essentialist metaphor (see Woolmer, 1976) for teaching while more emphasis placed on sociocultural approaches that emphasize scientific understand in the context of content-transcending themes (Kolstø, 2001). Such themes are recognized, extended, and defended in recent Science-in Context (SinC) frameworks in science education as evidenced by Socially Acute Questions, Socioscientific Issues (SSI), and Science Technology Society Environment initiatives (Bencze et al., in press). However, there is a challenge that exists for both teachers and students in understanding the tacit expectations in SinC classrooms, particularly when both have been historically immersed in more conventional essentialist pedagogical traditions (Berland & McNeill, 2010; Ivinson & Duveen, 2005; Zeidler & Sadler, 2008). In particular, students' challenge to elucidate what is expected of them in essentialist classrooms (Bernstein, 1974, 1981; Morais, Fontinhas, & Neves, 1992) has been suggested to be even more pronounced when introducing cross-curricular pedagogy (Elgström & Hellstenius, 2011; Zeidler, Sadler, Applebaum, & Callahan, 2009). However, students' difficulties to navigate the educational expectations have been given little attention in classroom studies, particularly in secondary school, where the curriculum tends to reside in discrete discipline silos.

The present study sets out to explore students' difficulties to enacting the educational expectations required in SinC curriculum. To attain our aim, we have chosen a teaching practice using SSI as a context for the study because this curriculum context is embedded in a progressive pedagogy that provides many inherent cross-curricular contexts (Zeidler, 2014). The present study aims at gaining further knowledge about how students interpret the educational demands present in a student-centered cross-curricular context. Knowledge about how students attempt to enact those demands is necessary for teachers' refinement of classroom communications that better support all students' interpretations of curriculum expectations in SinC settings.
The trend toward promoting scientific inquiry, argumentation, and socioscientific reasoning in science education was paralleled by a development of curricula that moved from an essentialist toward a progressivist pedagogy (Carlgren & Kallos, 1997; Elgström & Hellstenius, 2011; Kallos & Lundgren, 1976). To engage students in socioscientific reasoning, students need on the one hand, scientific knowledge that has typically been conveyed by the teacher through formal (essentialist) instruction, while on the other hand, make use of normative factors from other embedded in other disciplines such as moral reasoning, understanding multiple perspectives, evoking skepticism and the like (Sadler, Barab, & Scott, 2007; Zeidler, 2014). This means that the instruction may appear, at times, to promote conflicting essentialist and progressivist expectations that are inherently at odds with one another (Ivinson & Duveen, 2005; Moje, 1995; Scott, Mortimer, & Aguier, 2006). When the students encounter both scientific discourses, with a high degree of specialization, and everyday discourses, which has a low degree of specialization, they are challenged to interpret the rules and expectations for participating in the classroom discourse (Whitty, 2010; Young, 2008). This challenge is further complicated as students receive little support to understand the process of decontextualization (Lemke, 1990; Maton, 2013) for the purpose of acquiring knowledge that is typically more abstract and generalized. In contrast, the progressivist tradition of education invites concrete everyday knowledge as a starting point for abstract knowledge.

Inspired by progressivist pedagogy, during the last two decades, education for democratic citizenship has become part of science education curricula worldwide. Such attempts to promote students' competencies regarding participation in ethical and democratic discourses are known as SSI. The SSI framework (Ratcliffe, 1997; Zeidler, 2014; Zeidler & Sadler, 2008) explicitly demands cross-curricular and student-centered approaches to stimulate deliberative conversations on authentic problems derived from the use of science and technology in society. By engaging in socioscientific discourse and negotiating many different kinds of understandings, students have the opportunity to develop identities that enable them to participate in democratic decision-making regarding SSI (Sadler & Zeidler, 2009). SSI contexts have also been found to promote students' learning of skills associated with higher quality socioscientific arguments (Evagorou, Jiménez-Aleixandre, & Osborne, 2012; Osborne, Erduran, & Simon, 2004). Students have also been found to develop higher levels of reflective judgment, more informed understandings of nature of science viewpoints (Eastwood et al., 2012; Zeidler et al., 2009), and better understandings of scientific content (Klosterman & Sadler, 2010), and sensitivity toward others’ opinions (Fowler, Zeidler, & Sadler, 2009). However, there are problems. Concerns have been raised about students' abilities to employ argumentation skills, and develop critical thinking and reflective reasoning while engaging in student group discussions (Lindahl & Folkesson, 2016a; 2016b; Evagorou & Osborne, 2013; Nielsen, 2012; Osborne, Simon, Christodoulou, Howell-Richardson, & Richardson, 2013; Ratcliffe, 1997; Schalk, van der Schee, & Boersma, 2013). Still, the benefit of student group discussions for learning was confirmed in a review of the past 40 years' research (Howe & Abedin, 2013). Howe and Abedin (2013) concluded that little information is available on the modes of dialogic organization that support the intended learning. With the aim of better supporting students' group discussions, experimental studies have suggested that scaffolding through teacher guidance facilitates critical thinking and encourages students to engage better in discussions in a more robust and elaborate manner (Berland & McNeill, 2010; Driver, Newton, & Osborne, 2000; Duschl & Osborne, 2002; Gresch, Hasselhorn, & Bögelhoz, 2013; Ratcliffe, 1997; Sadler, Amirshokoohi, Kazempour, & Allspaw, 2006; Schalk et al., 2013). Despite such efforts, further research is needed to build a more thorough basis that promotes students' successful SSI discussions in terms of their meaning-making using multiple discourses for the purpose of fulfilling curriculum expectations. The intention with this study is to contribute to this field of research.
2.1 Science classroom discourses

Classroom discourses have been studied for decades to elucidate processes and their outcomes. In traditional (i.e., teacher-centered) science classrooms, the discursive norms tend to be strongly authoritative (Scott et al., 2006) and require students to learn how to respond to teachers’ prompts (Lemke, 1990). Students who can make use of their teacher’s responses in these settings tend to make relationships between meanings and implicitly learn how to build correct understandings by constructing principles and abstract knowledge from observations and examples, as well as how to appropriately use science language in a science class (Edwards & Mercer, 1987; Lemke, 1990). Such classrooms have been criticized for providing undisputable truths, “ready-made” science that is pointless to discuss (Gaskell, 1992), instead of allowing students to engage in a scientific discourse that affords dialogic interaction (Driver et al., 2000) using rational argumentation as a tool to construct explanations (Duschl & Osborne, 2002). However, classroom discourse is part of school culture, and assumed to take place in the classroom (Bloome, Puro, & Theodorou, 1989; Young, 2008). Hence, students are challenged when classroom practices changes, for example to support science discourse through argumentation (Berland et al., 2016; Berland & McNeill, 2010; Osborne et al., 2004). Studies on classroom discourse in settings inspired by the progressivist instructional paradigm have shown that when students are engaged in discussions with their peers, the learning process can result in the development of more effective scientific arguments (Berland & McNeill, 2010; Jiménez-Aleixandre, Bugallo Rodríguez, & Duschl, 2000; Osborne et al., 2004) as well as more complex reasoning (Evagorou & Osborne, 2013; Yoonsook, Yoo, Kim, Lee, & Zeidler, 2016), using different reasoning patterns (Sadler & Zeidler, 2005), and a variety of everyday discourses (Sadler et al., 2007; Zeidler & Sadler, 2008). It should be noted that although changes toward a more student-active classroom practice can have a significant impact on students’ reasoning skills (Osborne et al., 2004), their performance may be misleading if they instrumentally follow classroom procedures, that is “doing school” (Jiménez-Aleixandre et al., 2000), and use the given intellectual tools as ends in themselves (Berland et al., 2016).

Research focusing on how students can learn to produce a structurally sound scientific argument has made use of the Toulmin argumentation pattern (TAP; Toulmin, 1958). In this form, argumentation can be used to inquire further or to construct explanations, and dispute or make rational judgments of claims (Duschl & Osborne, 2002). TAP is an important tool for students to construct and evaluate claims regarding the relevance of personal as well as impersonal experiences for the purpose of meaning-making and dialogue. Hence, argumentation can potentially provide students with opportunities to connect general science ideas in their meaning-making (Berland et al., 2016). TAP is especially suitable for analyzing the degree to which an argument effectively combines science-content knowledge (Moon, Stanford, Cole, & Towns, 2016). Although TAP has limitations when it comes to assessing an individual student’s engagement in a discussion (Kelly & Takao, 2002; Walker & Zeidler, 2007), it has been used to assess the effectiveness of arguments in socioscientific reasoning (Grace, 2009; Osborne et al., 2004). To compensate for its limitations, TAP has been used in combination with other analytical methods (Evagorou & Osborne, 2013; Rudsberg, Öhman, & Östman, 2013). Evagorou and Osborne (2013) made use of “social modes of thinking” (Mercer, 1996) to analyze what rules of interaction students use in discussions. They showed that students provided information to one another in terms of argumentative claims (disputational talk), or built on or shared information through cumulative talk or exploratory talk. Exploratory talk has been associated with successful socioscientific reasoning in the sense that discussions exhibit complex reasoning (Evagorou & Osborne, 2013; Lewis & Leach, 2006), and is therefore in focus for the present study.

Research focusing on the complexity of socioscientific reasoning shows that successful SSI discussions depend upon students making use of a complex issue by critically examining different
perspectives (Yoonsook et al., 2016), while maintaining a sound skepticism of available information and realizing the necessity of continuing inquiry (Sadler et al., 2007). An important quality for successful group discussions seems to be students’ open-mindedness (Lindahl & Folkesson, 2016a), an attitude that is necessary for exploratory talk and an appreciation of the complexity of an SSI task. Thus, the task’s complexity is dependent on students’ introduction to and scrutiny of perspectives in their discussion; that is, they are expected to draw on the different discourses they have access to and negotiate them to produce a socioscientific discourse (Kahn & Zeidler, 2016a; Sadler & Zeidler, 2009). Such expectations can pose a tremendous challenge to students.

2.2 Students’ challenges when engaging in an SSI task

The past developments of curricula for science education have led to the existence of two conflicting educational philosophies in classroom practices—Essentialist and progressivist pedagogies (see Barrue & Albe, 2013; Zeidler, 2014). This creates problems because they introduce pedagogical discourses that send “mixed messages” of conflicting rules in the science classroom (Lemke, 1990) that can be difficult for students to distinguish. Furthermore, students’ different cultural backgrounds have made them familiar with contextualizing experiences in different ways, which in turn can be very different from the recontextualizing principles of the school (Young, 2008). Hence, the larger the incongruence between the students’ and the school’s culture, the larger will be their challenge to acquire the rules for knowledge production in the classroom. Progressivist pedagogy that invites everyday discourses into the classroom may increase students’ difficulties with interpreting what counts as desirable knowledge. In such cases, they adhere to the practice of an essentialist classroom context by keeping everyday discourses separate from school subject discourses (Whitty, Rowe, & Aggleton, 1994; Young, 2008). Either they misunderstand the purpose of including everyday discourses in the classroom practice, or they just do not know how to create a “third space” where they can make meaning of both school knowledge and personal knowledge (Moje, Collazo, Carrillo, & Marx, 2001). Hence, the purported benefits of progressivist pedagogy may be difficult to attain for many students.

In SSI, the cross-curricular approach includes the purposeful use of everyday discourses in order to facilitate students’ creation of a “third space” in the science classroom (Sadler et al., 2007; Zeidler & Sadler, 2008). However, when different discourses are invited into the classroom, it becomes particularly difficult for students to interpret what are the discursive rules. Ivinson and Duveen (2005) showed that students are likely to misunderstand the task without the explicit communication of what counts as knowledge in the classroom. They concluded that when subjected to new contexts, students often hold the erroneous belief that their previous experiences of schoolwork are appropriate in the new situation. Consequently, they need explicit explanations of the epistemic expectations for tasks in new contexts. However, the epistemic expectations for a task are part and parcel of curriculum expectations. Although a weakening of the boundaries between school knowledge and personal knowledge is desirable to support scientific literacy (Moje et al., 2001) and engage students in learning activities (Morais & Neves, 2001), the teacher needs to convey explicitly both the conditions under which evaluation criteria for each form of knowledge organically mesh and their relation to curricular goals. Hence, although progressivist pedagogy provides important opportunities for students to develop disciplinary knowledge as well as the skills to solve cross-curricular tasks, students need to overcome the challenges of novel communication rules that demand the use of weak boundaries between discourses. Therefore, a conceptual imperative exists to investigate students’ difficulties in acquiring an understanding for how to interpret and respond to the educational demands.
for such contexts to better benefit from the rich opportunities provided by progressivist pedagogy in science education.

3 | THEORETICAL FRAMEWORK

Student difficulties to understand what educational processes and products are required for academic success became a focus Bernstein's sociolinguistic theory (Bernstein, 1981, 2003). Bernstein (1974) created a theoretical model aimed at understanding why children's school success is connected to their social class. He created the theoretical concepts of recognition rules and realization rules for the purpose of describing students' challenges with regard to educational demands. According to Bernstein, recognition rules and realization rules are generally acquired implicitly. Recognition rules can be described as an understanding of what knowledge students are expected to produce and what discourses are legitimate to use. To acquire recognition rules, students must discern what counts as appropriate knowledge in a specific context and in a certain school subject; that is, how knowledge should be constructed to be valued in a particular classroom. This may be especially challenging in an SSI context, as well as other SinC contexts, where weak boundaries are desirable among sociocultural discourses where students are expected to promote the negotiation of meanings (see Sadler et al., 2007; Zeidler & Sadler, 2008). Weak boundaries allow the inclusion of different discourses into the students' discussions. This is desirable for SSI discourses because the students are expected to develop understandings for a variety of viewpoints and types of knowledge as they engage in deriving informed decisions. In contrast, strong boundaries between discourses are typical of a specialized subject matter discourse, such as that within conventional scientific disciplines. However, strong boundaries prevent the inclusion of different discourses into the students' discussion. This is not desirable in an SSI and other SinC contexts because the relationship between discourses cannot be explored and understood, which in turn prevents negotiation of the meanings of different discourses. Hence, discourses will be strictly confined to their meaning within their specific context. A change of rules toward the appropriateness of weak boundaries will be challenging for students in SinC settings. Bernstein's sociolinguistic theory is suitable for studying students' challenges to acquire new recognition rules, which is the result of the implementation of an SSI framework in the science curriculum. Students need to acquire recognition rules that guide them to realize which meanings fall outside the issue at hand and which may be reasonably integrated. When it comes to realization rules, students must not only acquire the recognition rules of a particular classroom. They must also convey valued knowledge to the teacher (and the class) in an appropriate manner (Bernstein, 2003). In other words, a student who has acquired the realization rules can more meaningfully participate by making use of concepts and discourses (i.e., the kind of text and the kind of talk) that are legitimate in a particular classroom context. Hence, a student who has acquired realization rules of a particular science classroom will participate successfully in the classroom practice and is likely to pass subsequent assessments.

The concepts of recognition rules and realization rules can be interpreted from students' understanding of the classroom discourse in terms of the relationships between subjects (teacher–student, student–student), spaces (the classroom and everyday life), and discourses (everyday and academic discourses). Hence, Bernstein proposed two basic concepts, framing and classification, for the purpose of describing and analyzing how learning activities in the classroom are controlled and what counts as knowledge.

Framing is used to explore different forms of communication with respect to its level of control in the relationships between teachers and students. If framing (teacher control) is strong, as in the
essentialist (i.e., traditional) instructional paradigm, the teacher has explicit control over the hierarchy of power in the classroom, the selection of content, the order in which things should be done (sequencing), the length of time students can work on a specific topic (pacing), and what the students are expected to learn. If framing is weak, as in the progressivist instructional paradigm, the students have more control over the communication and the classroom work (see Whitty, 2010). Hence, they are allowed to plan their learning activities, choose who to interact with, and what knowledge and discourses to actualize. In an SSI classroom, weak framing can, for example, be observed as students having some degree of control over their choice of information sources, making decision on how to explore and evaluate them and how to derive meaning from them. In progressivist settings, framing is to a large extent typically implicit (see Hoadley & Ensor, 2009). This aligns with research on classroom discourse that describes how different rules have to be implicitly learnt by the students to participate in an appropriate manner in the classroom practice (Lemke, 1990; Mehan, 1979; Mercer, 1996).

Classification refers to boundaries (i.e., the extent to which, e.g., different school subjects, such as natural science and social science, are kept apart from each other as well as from everyday knowledge). Strong classification is typical of traditional school discourse where each school subject has its own identity, along with strong boundaries from other school subjects. In such classrooms, students are expected to produce correct knowledge by, for example, providing “the right answer” when prompted. In contrast, weak classification means that school subjects and other discourses do not reside in isolated silos; they can be meaningfully put together in a discussion to support meaning-making in relation to the topic under consideration. This is expected when engaging in an SSI task, where natural science can be purposefully included with social science as well as with everyday knowledge discourses in a discussion. Bernstein suggested that a major challenge to students was to move beyond their personal experiences and their particular personal context (i.e., particularistic knowledge) toward the understanding of universal principles and abstract knowledge (i.e., universalistic knowledge).

4 | PURPOSE AND RESEARCH QUESTIONS

The aim of the present study was to explore how students interpret the educational demands present in a student-centered cross-curricular context. In other words, we will study the extent to which students acquire recognition rules to participate successfully in an SSI classroom. This context is particularly challenging for students because it can be described as having both weak framing and weak classification. Our research is guided by two specific research questions, which are presented below with their corresponding rationale.

Research question 1: What characterizes students' successful recognition of educational demands in a classroom with weak classification and weak framing?

Rationale (RQ1): Students face the challenge of interpreting what knowledge they are supposed to tap into when confronted with the educational demands typical of SSI-related instruction. The use of SSI exemplifies cross-curricular classroom practices that take advantage of weak classification to develop students' reflective thinking, reasoning skills, scientific knowledge, and character (Zeidler & Sadler, 2008). To the best of our knowledge, research that specifically addresses students' recognition rules of an SSI classroom has not been conducted. Such knowledge is crucial for the development of fruitful communication in SinC classroom based on progressivist pedagogy. Here, the SSI classroom is a particular illustrative example.
Research question 2: What characterizes students' unsuccessful recognition of educational demands in a classroom with weak classification and weak framing?

Rationale (RQ2): Cross-curricular classroom practices (i.e., weak classification) are challenging for students because no one uniform discourse is desirable; many types of discourses can be appropriate to actualize (Whitty, 2010). The Swedish national curriculum favors weak framing, which can create difficulties for students to acquire recognition rules. Such difficulties tend to be present because students are either reluctant or too conditioned to venture away from previous experiences of strongly framed classroom practices (Ivinson & Duveen, 2005). Because the SSI classroom in our study is considered to foster both weak framing and weak classification, it is logical and necessary to explore what characterizes students' unsuccessful recognition of these new educational demands. Knowledge on students' difficulties in interpreting what is expected of them in SinC setting is valuable for promoting students' engagement in group discourse, including (but not limited to) debate, discussion, argumentation, town-hall style forums, and the like.

5 | DESIGN AND METHODS

5.1 | Participants

The 23 participants (14 females and 9 males) were 15- to 16-year-old students attending a public upper secondary school with approximately 900 students in a small Swedish city. The school catchment area includes rural as well as urban areas and enrolls students from middle to high SES. The participants were enrolled in a preparatory class required for higher education, and participated in “Science Studies.” This is a compulsory course for all nonscience students in the upper secondary school in Sweden, and covers aspects of sustainable development, human sexuality and relationships, individual health and lifestyle, and biotechnology and its implications.

Prior to the study, the students were informed about the general nature of the project, data collection, and data handling, and were also given the opportunity to decline from participating in the data collection phase. The class had 28 students divided into five groups. One student declined with the consequence that we refrained from recording his and his group's discussions, resulting in 23 students in four groups for which data could be reported.

The teacher decided on the group size (4–6 students) for SSI discussions, whereas the authors decided on how the groups should be assembled. Because Bernstein (1974) considered socioeconomic factors relevant for understanding students' habits of using sociolinguistic codes, we have made efforts to fit our study with his theoretical framework. Although SES-values can be of importance in large-scale studies, they may be misleading in small case studies. Inasmuch as we focused on the use of sociolinguistic codes, students' use of elaborated language, (i.e., explanatory justifications) was used to assemble the groups. This was accomplished by analyzing students' argumentative text on an SSI prior to the one reported on here. These particular homogeneous groups were formed in order to maximize equal opportunities for students to express themselves. Each group was composed of both male and female students.

5.2 | Classroom context

The teacher had 4 years’ experience teaching science and had participated in a 15 European Credit Transfer and Accumulation System (ECTAS) course for practicing teachers on the use of SSI in science education. The course was taught by one of the authors of this article and followed the SSI
framework advanced in “The role of moral reasoning on SSI and discourse in science education” (Zeidler, 2003). During the school year preceding this study, the classroom teacher had implemented the use of SSI in “Science Studies” throughout the academic year (90 hr of instructional time). Two external scholars (authors 1 and 2) with expertise in SSI observed part of the course. They confirmed that the class was clearly more student-centered than teacher-centered and followed appropriate SSI-related pedagogy.

The “Science Studies” course was composed of five major SSI units of study. The teacher designed all these units without any input by the authors. The SSI unit, the focus for the present study, titled “Wolves in Sweden and Biodiversity,” was the second SSI unit presented to these students. We selected this particular unit for observation because the students were near the beginning of experiencing a novel teaching approach. The previous SSI task had included a lesson on how to build an argument in relation to their attempts to write an argumentative text. Also, before starting the SSI unit, the teacher had presented a lesson to recall the students' previous knowledge on genetics and ecology (the focus of biology in lower secondary school in Sweden is on ecology and sustainable development). The background for the SSI project was introduced to the students through an intentionally short (5 min) lecture. Intended to serve as an advanced organizer, it covered the inbreeding of the Swedish wolf population (population size 350 wolves), how the authorities attempted to resolve the problem, and how different stakeholders engaged in the public debate on the issue. The exact information is transcribed and can be accessed in the online supplemental material (Supporting Information Methods S1). None of the students had experienced a personal encounter with a wolf, but they were well aware that wolves occasionally passed by in the region.

The students were given three prompts for their group discussions: (i) What is your opinion? (ii) How can you understand the different perspectives of the debate? (iii) Give your view on the different perspectives. To facilitate students in attending to the given prompts, they were given two newspaper articles presenting the views of different parties of interest. The conflicting views were related to scientific facts including that the Swedish wolf population is inbred (the descendants of merely five genetically different wolves), the introduction of wolves from other gene pools (Russian wolves), the size of the Swedish wolf population, a conceivable impact on reindeer husbandry, and the opinions of the Swedish hunters as well as environmental organizations.

The students' task was to make use of available knowledge and the different aspects of the issue in a discussion where their own thoughts, opinions, and feelings, and those of other parties should be included. The explorative discussion was intended to give the students an opportunity to develop their understanding of the different perspectives using reflective reasoning, and ultimately, on an individual basis, come to an informed decision on the issue. Hence, the nature of the task implied weak boundaries between school discourse and other discourses in order to produce a variety of new meanings while including different discourses in the discussion. Furthermore, the implicit nature of the instructional demand implied that the students, independently of teacher control but with the aid of guiding questions, should take responsibility for how the discussions evolved. Hence, the teacher had no control over pacing, selection of content and criteria for communication. The purpose of the discussions was to facilitate the writing of individual argumentative texts. However, because the texts were to be assessed by the teacher at the end of the SSI project, teacher control was strong with regard to evaluation. Subsequently, the students were subjected to mixed messages regarding teacher control.

5.3 | Data

Audio recordings from four group discussions were collected during the first two lessons of the SSI project. These lessons were dedicated to student group discussions to explore the different
perspectives related to the issue for the purpose of reaching informed consent on group decisions. The two consecutive lessons (60 min each) occurred on two subsequent days. They involved an initial lecture given by the teacher, instructions for the task, and short interspersed classroom discussions. Students sat during parts of the two lessons in small groups and discussed the issue (between 20 and 25 min each day). During both lessons, the classroom discussions occurred first within the small groups and then between the teacher and the student groups in a whole class discussion. The latter was done with the purpose of making the student groups aware of the presence of presumably different positions adopted by other groups without judgment.

5.4 Analysis

The recorded discussions were transcribed verbatim and analyzed independently by two of the authors. These same two researchers had made first-hand observations of the classroom during two previous semesters and had previous experience analyzing similar group discussions. To validate the transcriptions, both authors listened to audio recordings while reading the transcripts to ensure that they were accurately made and to make any necessary corrections. Transcripts were divided into parts in which the students discussed a theme. A theme can be described as initiated by a question, claim, problem, or dilemma that was discussed until that particular discussion ended without being further questioned, problematized, or elaborated on, and which was instead followed by a new theme with or without a pause in the discussion.

In the first step, the excerpted themes were analyzed to interpret what discourses students introduced or alluded to. This analysis was guided by Gee’s (2005) framework, making use of the notion of small discourses, “language-in-use”, in the form of phrases or sentences that signal that they are parts of larger discourses. For example, themes could contain single or combined discourses (everyday discourse in one utterance and a school subject discourse in the following utterance). Combined discourses could consist of one or more substantive conversational turns, such as a single student’s utterance containing some kind of information beyond “yes,” “what,” etc., referring to information from others. Thus, the students could be addressing one or more perspectives of the issue in a theme or in a single utterance. Combined discourses, however, were usually discussions in which the students elaborated or commented on each other's utterances, whereas single discourses were not elaborated on. Excerpts that were not comprehensible (words or fragmented phrases that could not be understood in the context) were excluded from further analysis because they were not considered part of the students’ discussion. The excluded excerpts contained 196 conversational turns, or 31.2% of the total number of conversational turns.

In a second step, excerpts were analyzed with regard to students’ recognition of the educational demands in relation to the given task, which was to produce a socioscientific discourse. This was performed by using an operationalized definition for recognition rules and realization rules derived from Bernstein's (1974, 2003) model. The operationalization made by one of the authors was also based on previous studies in primary school science education contexts (Morais et al., 1992), but adapted to a secondary school context.

Successful recognition was defined as students' production of an SSI discourse by making relevant discourses that referred to meanings related to their own or others' perspectives on the issue. Successful recognition also includes considering additional relevant discourses to produce new meanings in a cogent manner. By including and giving significance to a variety of different discourses, students' discussions can be interpreted as exhibiting weak boundaries. Hence, they appear to be guided by a recognition rule for constructing knowledge using weak classification of the different discourses.
Unsuccessful recognition was defined as students refraining from making use of discourses with relevance for the SSI at hand. For example, students excluded discourses by making others’ utterances irrelevant by ignoring, not elaborating on, or bluntly rejecting them. Exclusion of discourses indicated that the students maintained strong boundaries (strong classification) between the different perspectives. In such instances, there were little or no opportunities to build a collective understanding of the SSI under consideration.

To understand students’ successful and unsuccessful recognition of educational demands in more detail (i.e., how students were or were not able to produce a meaningful socioscientific discourse), excerpts were analyzed using Bernstein’s (1974, 2003) concepts of universalistic and particularistic meaning. As reported above, different forms of meaning are made relevant or irrelevant through discursive rules (Edwards & Mercer, 1987; Lemke, 1990). Hence, abstract knowledge and principles can be made useful or irrelevant depending on what is considered familiar (within-culture knowledge) or unfamiliar (out-of-culture knowledge). Students are expected to get more proficient, or at least more familiar with, using principles and abstract scientific knowledge through years of science studies. Hence, they can acquire scientific knowledge that is unfamiliar in relation to their personal observations, but which can form part of everyday knowledge. To build such knowledge, students are invited to use their personal observations to build decontextualized knowledge by forming abstract understanding (universalistic meaning) of concrete knowledge. However, this is where educational practice needs further development (Berland et al., 2016; Driver et al., 2000; Lemke, 1990; Maton, 2013).

Universalistic meaning will, for the purpose of our analysis, be defined as students’ utterances drawn on understandings based on principles, general understanding of scientific knowledge, a position/perspective, or a global view representing innumerable people.

Particularistic meaning is conveyed when students in their utterances draw on understandings relating to personal and local views that relate to concrete persons, places, or solutions, thus putting the issue into a narrowly focused, limited context.

The analytical concepts were used by two of the researchers in collaboration in order to explore the data for the purpose of fine-tuning the operationalized definitions to fit this sample and context. Hence, the definitions were adjusted for secondary school students’ successful and unsuccessful recognition and realization in a context with weak framing. Students’ successful recognition of educational demands was defined as their production of a meaningful SSI discourse consistent with teacher expectations. A meaningful SSI discourse in this context is interpreted as students using differing and/or conflicting perspectives in their discussions, which are relevant to the issue, to gain greater understanding in their pursuit of eventually forming an informed decision. To be considered a relevant perspective, students’ utterances have to confer meanings that relate to any knowledge and/or agent’s view, such as themselves, other laypeople, or specific stakeholders, which has an apparent connection to and impact on the issue under consideration.

In the analytical procedure, two of the researchers independently and inductively categorized the excerpts exhibiting unsuccessful recognition; that is, what the students appeared to engage in instead of what they were expected to do. To characterize students’ recognition further, one of the researchers analyzed the categorized excerpts using the concepts of universalistic and particularistic meaning. In the Results section below, excerpts of the students’ discussions are presented. The excerpts were translated from Swedish to English by a bilingual senior lecturer in English and discussed with the authors. The different discourses the students alluded to have been given descriptive names (short phrases), which appear in our interpretative text. The content of the discourses is described in the supplementary material accompanying the online article (Supporting Information Methods S2).
6 | RESULTS

By using the operationalized definitions of successful and unsuccessful recognition, eight excerpts were assigned to a category for successful recognition. We also found 50 excerpts that exhibited unsuccessful recognition. Further interpretation of these excerpts resulted in four categories. The initial agreement between the researchers regarding the excerpts belonging to the categories was calculated at 83.3%. After a discussion on the rubrics for the two sets of categories, 100% agreement was reached as well as a more precise rubric for the categories. More information on the raw data for each category is described in the supplementary material accompanying the online article (Table S1). The characterization of students' successful and unsuccessful recognition of educational demands follows below. Throughout this section, the students use a number of discourses that are further described together with supplementary results accompanying the online article (Supporting Information Methods S2). The different discourses are numbered to make their occurrence and reoccurrence conspicuous. The students' manners of elaborating and building upon discourses with the use of universalistic (u) and particularistic (p) meanings are also indicated for each conversational turn that contains sufficient information for this analysis.

6.1 | Students' successful recognition of appropriate discourse

Typically, students' successful recognition was seen as their production of a meaningful SSI discourse that integrated different discourses connected to the SSI. In the example below (Table 1), the students build a collective understanding of the issue at hand by integrating their views on the discourses they actualize into the discussion. Two important observations should be made. First, the students found ways to elaborate on or question each other's input in a manner that promoted the development of others' or their own claims. Second, by considering two discourses simultaneously, they succeeded in including all of the discourses the group members suggested as the discussion continued. The excerpt presented below exemplifies a discussion in which discourses with weak boundaries are negotiated, which in this context reflects students' recognition. Note that the students' utterances often convey decontextualized general knowledge/meaning that is close to or resembles a principle (i.e., universalistic meaning [u]). However, there are also examples of personal and context-dependent meanings (i.e., particularistic meaning [p]), which are elaborated on by means of universalistic meanings. Supplementary data on which the results regarding students' successful recognition are based is shared as supplementary material accompanying the online article (Table S2).

In the example below, an SSI discourse is displayed that typically includes different discourses that are both questioned and elaborated on in a manner that makes them all relevant for the task. The movement of the discussion revealing the inclusion of the different discourses indicates weak classification between discourses. Weak classification between the actualized positions and perspectives is crucial for an SSI discourse and is, therefore, an indication of recognition of the appropriate discourse in relation to curriculum expectations.

As mentioned previously, weak classification between the actualized perspectives is crucial for an SSI discourse and is, therefore, an indication of recognition of the appropriate discourse in relation to the given task. Indications of weak classification are observed when the students consider two discourses of their own or in relation to a previous utterance. Such considerations frequently occur when one or both discourses are expressed in a universalistic (u) manner. Although the students use universalistic meaning frequently, particularistic (p) meanings do occur. The movement of students' discussions between universalistic and particularistic meanings while building an understanding of the issue, without interrupting the conversation, indicates that they also have weak boundaries between
impersonal and personal contexts. This allows for additional complexity because the students not only include different perspectives but also engage in meaning-making on different levels of abstraction by relating to general and decontextualized knowledge as well as to familiar or contextualized contexts. Hence, the SSI is made understandable on different abstract levels.

6.2 | Students' unsuccessful recognition of appropriate discourse

Students' unsuccessful recognition of the appropriate discourse when given an SSI task were interpreted as: (i) students rejecting the relevance of the SSI task; (ii) students deviating from the focus of the task; (iii) students interpreting the task as an exchange of opinions; and (iv) students interpreting the task as producing answers to the teacher's questions. Examples of representative excerpts for all

---

**TABLE 1** Students' successful recognition of appropriate discourse

<table>
<thead>
<tr>
<th>Students' utterances</th>
<th>Discourse type and meaning</th>
<th>Interpretation of discourses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Henry: I read an article in the paper where a wolf had attacked people who were out in the woods</td>
<td>1 u</td>
<td>The Wolves as a human threat discourse (D1) is introduced in a general way (u).</td>
</tr>
<tr>
<td>Tina: Yeah, I get that as well, like. Would parents, like, let out their five-year-old, when they know that there's a wolf [about], like. That ain't gonna work!</td>
<td>1 p</td>
<td>Wolves as a human threat (D1) is acknowledged and elaborated on, in a general way (u).</td>
</tr>
<tr>
<td>Elaine: But really, for sure, I think we should have wolves, But, because they're not an endangered species ...[so culling is OK]</td>
<td>2 p</td>
<td>D1 is contradicted with an emphasized personal opinion (p). Students' idea to preserve the wolf (D2), thus strengthening the boundaries (C+) toward the Human threat (D1).</td>
</tr>
<tr>
<td>Tina: But if they're a threat to the public, then maybe we should [control them], like</td>
<td>1 u</td>
<td>The dilemma (u) is acknowledged and elaborated on, Wolves as a human threat (D1) is considered together with Need to control the wolves (D3), thus weakening the boundaries (C−) between these two discourses.</td>
</tr>
<tr>
<td>Elaine: Yeah, so where there are many people, maybe you shouldn't encourage wolves</td>
<td>3 u</td>
<td>Need to control the wolves (D3) is suggested as a possibility in a general way (u), which is considered together with Students' idea to preserve the wolf (D2), thus weakening the boundaries (C−) between these two discourses.</td>
</tr>
<tr>
<td>Henry: But where in Sweden should they be, if there are reindeer in the North. [the discussion continues without delay below]</td>
<td>3 u</td>
<td>Problematizes Need to control the wolves (D3u) by associating it with the Indigenous people's view (D4u), thus weakening boundaries between these discourses (C−).</td>
</tr>
<tr>
<td>Tina: There are large forests in the middle of Sweden!</td>
<td>3 p</td>
<td>Need to control the wolves (D3p) is given a concrete solution, in response to previous utterance.</td>
</tr>
<tr>
<td>Elaine: I don't really know, I don't understand. [The discussion continues based on the actualized difficulty. To read the full excerpt, see Table S2]</td>
<td>–</td>
<td>Elaine expresses frustration over difficulties.</td>
</tr>
</tbody>
</table>

**Note.** The students use the following discourses: (D1) Wolves as a human threat, (D2) students' ideas to preserve the wolf, (D3) need to control the wolves, and (D4) indigenous people's view. Universalistic (u) and particularistic meanings (p) are indicated for each input that contains sufficient information for this analysis.
four categories are presented. Although the groups' discussions might show short passages of appropriate discourse, they appeared to have difficulties with maintaining the appropriate SSI discourse (i.e., weak classification \(C^-\)). The students' difficulties were usually manifested in their strengthening of boundaries \((C+\)). Occasionally, the students diverted from the task by weakening the boundaries between discourses too much \((C--\)).

6.2.1 Students rejecting the relevance of the SSI task

The teacher had encouraged the students to engage in an SSI discourse; that is, to integrate school subject discussions with a variety of discourses relevant to the issues at hand. Occasionally, the students rejected the relevance of the SSI task. This was done in two different ways: The students avoided the discussion by (i) uncritically proposing acceptance of the decisions made by authorities, or (ii) stressing the irrelevance of the issue to their local context. Hence, they did not engage in meaning-making of the task because it was not important for them to decide.

The excerpt in Table 2a illustrates how students could reject the relevance of the SSI task by suggesting that they should accept the decisions of authorities as well as legitimate experts (i.e., using the Trust in authorities discourse). Supplementary results regarding students' rejection of the relevance of the SSI task are shared as supplementary material accompanying the online article (Table S3a). The students show a lack of guidance from recognition rules because they restrict the discussion by pointing out that there is a particular discourse in society that they should comply with, instead of engaging in a discussion to explore the meaning of other discourses.

Below, the students suggest that the group should trust authorities or legitimate experts, which is expressed as a personal opinion. Despite the invitation to explore and negotiate the meanings of the different discourses (second prompt: How can you understand the different perspectives of the debate?) within the wolf debate, they make no attempts to weaken boundaries between discourses by giving no consideration to any other discourse beyond the one initially expressed. The students are seen to refrain from reflective reasoning by rejecting other discourses as they leave the theme of the discussion without questioning the claim.

By accepting the decisions of authorities or legitimate experts without scrutinizing the foundations of their decisions, the students engage in keeping strong boundaries between a chosen stakeholder's decision-making discourse and other possible discourses. They seem not to understand that they are expected to explore and negotiate the meanings of available discourses related to the SSI task; instead, they make the task irrelevant to themselves. In doing so, they make a strong classification between their role as participants in a discussion and that of authorities or experts. They use both universalistic and particularistic meanings in their reasoning toward a temporary stop of the conversation. Universalistic meanings (conveyed by the Trust in authorities discourse) are used to strengthen the particularistic meaning conveyed as a personal opinion.

The students were also found to reject the relevance of the SSI task by questioning its relevance to their local context. The excerpt in Table 2b exemplifies how the SSI is made irrelevant by drawing on the No personal relevance discourse (i.e., claiming that there are no wolves where they live). Supplementary results regarding students' rejection of the relevance of the SSI task are shared as supplementary material accompanying the online article (Table S3b). Unsuccessful recognition is exemplified by the students' lack of reflective reasoning regarding everyday knowledge. Without any skepticism toward everyday discourse regarding the personal and local contexts, the rejection of other discourses indicates strong boundaries between discourses.

In the excerpt above, the students rejected the ongoing SSI discourse with the aid of knowledge of their local context (i.e., particularistic meaning). The turn from a universalistic meaning toward a
particularistic meaning indicates strong boundaries between the SSI discourse and the everyday discourse that follows. Hence, the examples indicate unsuccessful recognition of appropriate SSI discourse because there is a strong classification between discourses in the students’ discussion.

6.2.2 | Students deviating from the focus of the task

It is challenging to remain focused on developing an understanding of a number of different perspectives relevant to an issue, instead of turning to other topics of conversation. To maintain focus on an

<table>
<thead>
<tr>
<th>Students’ utterances</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Example 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The discussion begins by Charles recalling a previous discussion on subsidizing the indigenous people for losing reindeer to the wolves. Something he objects to. Instead he suggests reducing the wolf population as proposed by the Minister of Environment.</td>
<td>3p</td>
<td>The suggestion to subsidize the indigenous people is contradicted using the Need to control the wolves (D3) discourse, forwarded as a personal opinion (p). The Trust in authorities (D12) discourse is added, in a general way (u) to support D3.</td>
</tr>
<tr>
<td>Charles: Yeah, but the subsidies... reduce...[implies the wolf population]</td>
<td>12u</td>
<td>The Trust in authorities (D12) discourse is acknowledged (u) and then emphasized with a personal opinion (p), thus strengthening its boundaries (C+) toward other stakeholders’ discourses.</td>
</tr>
<tr>
<td>Rachel: Yeah, she ought to have some idea, I think, I believe she's there for a reason, so she ought to know what she's doing</td>
<td>12a 12p</td>
<td>The minister's proposition is left without further discussion. The group continue their discussion on another theme.</td>
</tr>
<tr>
<td>Example 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frank: They [the wolves] cause problems you know, like this...</td>
<td>1u</td>
<td>The Wolves as a human threat (D1) discourse is introduced in a general way (u).</td>
</tr>
<tr>
<td>Harry: Yeah, but what do you mean?</td>
<td></td>
<td>The Wolves as a human threat (D1) discourse is questioned.</td>
</tr>
<tr>
<td>Frank: If you, it's more about people, really, think if you were walking around here</td>
<td>1u 1p</td>
<td>The Wolves as a human threat (D1) discourse is first elaborated on in a general way (u) and then alluding to a local context (D1p).</td>
</tr>
<tr>
<td>Miriam: But not here in Emmaboda [the student's hometown]. I don't think so.</td>
<td>11p</td>
<td>The Wolves as a human threat (D1) discourse is rejected using No personal relevance (D11), a local context (p). This hampers further discussion on the theme.</td>
</tr>
<tr>
<td>Frank: Yeah, but still.</td>
<td></td>
<td>[Frank continues to argue for taking the perspective of those having wolves in the neighborhood while the others joke about foxes in their neighborhood.]</td>
</tr>
</tbody>
</table>

Note. The students used the following discourses: (D3) need to control the wolves, (D12) trust in authorities, (D1) wolves as a human threat, and (D11) no personal relevance. Universalistic (u) and particularistic meanings (p) are indicated for each input that contains sufficient information for this analysis.
issue, students need to distinguish between irrelevant and relevant topics. In this study, although there were utterances that could initiate reflective reasoning, other students did, at times, reject the relevant discourse and engage in discussions on topics far from the focus of the SSI. The excerpt below (Table 3) exemplifies students' unsuccessful recognition of the appropriate discourse. The discussion in the excerpt starts soon after a student has raised the question of the possible impact on the populations of prey animals if the Swedish wolf was eradicated. Supplementary data regarding students' deviation from the focus of the task are shared as supplementary material accompanying the online article (Table S4).

**TABLE 3** Students' unsuccessful recognition of appropriate discourse: Deviating from the focus of the task

<table>
<thead>
<tr>
<th>Students' utterances</th>
<th>Discourse type and meaning</th>
<th>Interpretations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miriam: <em>If you don't have a balance between the animals, it won't be good</em></td>
<td>14u</td>
<td>The <em>Principle of ecological balance</em> (D14) discourse, presented in a general way (u), is used to problematize the discussion (in favor of keeping the wolf).</td>
</tr>
<tr>
<td>Maria: <em>But if you shoot all the wolves, then the hunters can shoot something else [casually expressed]</em></td>
<td>15p</td>
<td>The <em>Hunter's view</em> (D15) discourse, as a concrete solution (p), is used to reject the <em>Principle of ecological balance</em> (D14) discourse as a motive for keeping the wolf. This strengthens the boundaries (C+) between theses discourses.</td>
</tr>
<tr>
<td>Miriam: <em>But, should they really go about (giggles) shooting hares all the time?</em></td>
<td>–</td>
<td>Miriam laughs at Maria's solution and introduces a less serious attitude into the discussion.</td>
</tr>
<tr>
<td>Frank: <em>Yeah, they sure can do that too</em></td>
<td>15p</td>
<td>Supports D15. Personal opinion.</td>
</tr>
<tr>
<td>Miriam: <em>There's a load of hares</em></td>
<td>16p</td>
<td>Miriam draws on the <em>Impact of prey population size</em> (D16) discourse, based on personal observations (p).</td>
</tr>
<tr>
<td>Frank: <em>It's fun, but a little more difficult.</em></td>
<td>15p</td>
<td>The <em>Hunter's view</em> (D15) discourse is used in personal way (p) that seem to move the discussion away from the issue of the task. This indicates too weak boundaries (C−−) between the hunter's view discourse and discourses unrelated to the task. Here the group discussion starts to deviate from the task.</td>
</tr>
<tr>
<td>Miriam: <em>'Cause you don't see them too often.</em></td>
<td>16p</td>
<td>Miriam builds on the previous utterance using the <em>Impact of prey population size</em> (D16) discourse, based on personal observation (p).</td>
</tr>
<tr>
<td>Frank: <em>Yeah, here at our schoolyard there are loads</em></td>
<td>16p</td>
<td>Miriam's utterance is questioned using the <em>Impact of prey population size</em> (D16) discourse, based on personal observation (p).</td>
</tr>
<tr>
<td>Maria: <em>They are so cute</em></td>
<td>17p</td>
<td>Maria introduces the <em>Human-animal relationship</em> (D17) discourse in a personal context (p). The <em>Human-animal relationship</em> discourse as it is presented here is unrelated to the issue. The too weak boundaries (C−−) between Maria's utterance and discourses unrelated to the issue exemplify how the students deviate from the task.</td>
</tr>
<tr>
<td>Miriam: <em>No, not the little ones.</em></td>
<td>17p</td>
<td>Miriam gives her view (p) on the disconnected <em>Human-animal relationship</em> (D17) discourse.</td>
</tr>
</tbody>
</table>

Note. The students use the following discourses: (D14) principle of ecological balance, (D15) Hunter's view, (D16) impact of prey population size, and (D17) human–animal relationship. Universalistic (u) and particularistic meanings (p) are indicated for each input that contains sufficient information for this analysis.
The excerpt above shows how the students' discussions deviate from the SSI regarding the management of the Swedish wolf (“… have a balance between the animals…”) toward the students' personal feelings regarding peripheral issues. The students take a somewhat cavalier attitude toward the issue (“…the hunters can shoot something else…”). They put an aspect of the SSI into a local context (i.e., loads of hares at the schoolyard), and then they take the discussion further into a personal context (i.e., whether or not hares are cute). Hence, the manner of using particularistic meaning can result in deviating from the task. The students' unsuccessful recognition of appropriate discourse here is interpreted as having too weak boundaries toward discourses with a personal context. Thus, their overly weak classification regarding everyday discourses associated with their personal feelings interfere with their attempts to engage in a constructive SSI discourse. Apparently, when this occurs, the discussion loses focus because they cannot distinguish between relevant and irrelevant discourses for an SSI task.

6.2.3 | Students interpreting the task as an exchange of opinions

The students had been instructed to discuss different positions and perspectives on the SSI in order to make an informed decision on the management of the Swedish wolf population. They had been given three guiding questions for the group discussions. The first question prompted them to exchange and discuss their personal opinions, whereas the second guiding question was intended to stimulate a discussion to develop an understanding of the different perspectives of stakeholders and laypeople. Guiding question three was intended to encourage the students to take the discussion further, to make better informed decisions—the ultimate goal of the task. The teacher had explained the purpose of each question, and they had already been asked in the first guiding question to discuss their personal views. Without guidance from recognition rules, they misinterpret the subsequent questions in a manner that their personal opinions become the focus of the discussion. Although personal opinions are important for the SSI discourse, they should, as with other discourses, be negotiated to make meaning of the available perspectives on the SSI. The excerpt in Table 4 shows how the students exchange opinions and use them as “givens,” instead of unpacking them for further understanding.

Supplementary results regarding students' interpretation of the task as an exchange of opinions are shared as supplementary material accompanying the online article (Table S5).

<table>
<thead>
<tr>
<th>Example 1</th>
<th>Students' utterances</th>
<th>Discourse type and meaning</th>
<th>Interpretations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charles</td>
<td>It's not an animal you play around with. It's the most dangerous animal in Sweden.</td>
<td>1p Wolves as a human threat (D1) discourse is introduced as a personal opinion (p).</td>
<td></td>
</tr>
<tr>
<td>Michael</td>
<td>Are they really?</td>
<td>-</td>
<td>Michael responds with interest and surprise.</td>
</tr>
<tr>
<td>Charles</td>
<td>But they don't do anything useful</td>
<td>2p Questions the Students' idea to preserve the wolf (D2) discourse as his personal opinion (p). The statement is not questioned, elaborated on, or considered in relation to any other discourses, thus indicating strong boundaries (C+) toward other discourses.</td>
<td></td>
</tr>
</tbody>
</table>

[Murmurs follow and then the discussion turns toward the problem how to reduce the number of inbred wolves.]

Note. The students used the following discourses: (D1) Wolves as a human threat and (D2) Students' idea to preserve the wolf. Universalistic (u) and particularistic meanings (p) are indicated for each input that contains sufficient information this analysis.
Instead of engaging in a discussion to understand the different sides and ultimately make decisions, the students expressed their initial personal opinions without negotiating them in the group. The conversation suggests that these students had difficulties with interpreting which was the expected discourse they should produce, because there were no signs of reasoning for the purpose of understanding the epistemic basis of those personal opinions or to consider them in relation to other perspectives. Instead, the students' personal opinions exemplify particularistic meanings embedded in strong classification, sustained, or exchanged without negotiation as to what they mean in relation to other perspectives.

6.2.4 Students interpreting the task as producing answers to the teacher’s questions

Students undertaking the task as an enterprise to find “correct” answers to satisfy a traditional school task was interpreted as unsuccessful recognition. In such instances, the students produced concrete solutions for the SSI as if they were answering the teacher's question. Their solutions were narrow-minded in the sense that they simplified the issue by diminishing the problematic aspects, thereby avoiding the dissonance that such issues may entail. In the example below (Table 5), the students' solutions focus on separating wolves from livestock and humans that might otherwise be threatened. Hence, they simplified the SSI to a practical problem that can be easily solved. Supplementary results regarding students' interpretation of the task as producing answers to the teacher's questions are shared as supplementary material accompanying the online article (Table S6).

The excerpt below shows students' unsuccessful recognition in that they reduce the problematic discourse, instead of engaging in an SSI discourse. The students reject other discourses to find a simple solution. They demonstrate strong classification between discourses, because they refrain from considering discourses that threaten the solution. More specifically, the students use particularistic meanings to build the answer and to strengthen their case toward the universalistic meanings that complicate the issue.

### TABLE 5 Students' unsuccessful recognition of appropriate discourse. Answering the teacher's questions

<table>
<thead>
<tr>
<th>Students’ utterances</th>
<th>Discourse type and meaning</th>
<th>Interpretations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ernest: But still, the reindeer keepers they must [feel]…</td>
<td>4u</td>
<td>The Indigenous people's view (D4) discourse is introduced in a general way (u).</td>
</tr>
<tr>
<td>Olav: But I don't understand, can't they build better fences?</td>
<td>18p</td>
<td>The Need to control the reindeer (D18) discourse, a concrete solution (p), rejects the Indigenous people's view (D4) discourse. Thus, the boundaries between the discourses are strengthened (C+).</td>
</tr>
<tr>
<td>Ernest: Uhu.</td>
<td>–</td>
<td>Agrees</td>
</tr>
<tr>
<td>Iona: Yes.</td>
<td>–</td>
<td>Agrees</td>
</tr>
<tr>
<td>Olav: Right?</td>
<td>–</td>
<td>Agrees</td>
</tr>
<tr>
<td>Ernest: Maybe.</td>
<td>–</td>
<td>Agrees</td>
</tr>
<tr>
<td>Olav: It should be totally possible, you know, to stop wolves from getting inside at all.</td>
<td>18p</td>
<td>The Need to control the reindeer (D18p) discourse is elaborated on.</td>
</tr>
<tr>
<td>Ernest: Yeah, that should be doable.</td>
<td>–</td>
<td>Agrees</td>
</tr>
<tr>
<td>Olav: Yes, sure. Right?</td>
<td>–</td>
<td>Agrees</td>
</tr>
<tr>
<td>Iona: Yes, that shouldn't be so hard.</td>
<td>–</td>
<td>Agrees</td>
</tr>
</tbody>
</table>

Note. The students use the following discourses: (D4) indigenous people's view, (D18) need to control the reindeers. Universalistic (u) and particularistic meanings (p) are indicated for each input that contains sufficient information for this analysis.
7 | DISCUSSION

Our aim was to explore students' understanding of the rules for producing meaningful discourse in a progressivist-inspired classroom context. This is of particular importance because classroom studies of such contexts are scarce, especially in an upper secondary school context. This study contributes by adding to present knowledge on how students interpret what they are supposed to accomplish in this kind of classroom environment. Furthermore, our study also contributes to the understanding of the ways students make meaning of the variety of discourses available in an SSI context.

Students have been described as having more or less difficulties with grasping the rules for talking science in a science classroom (Driver et al., 2000; Duschl & Osborne, 2002; Edwards & Mercer, 1987; Lemke, 1990; Moje et al., 2001). The problem for students to engage in “doing science” instead of “doing school” concerns their difficulties with interpreting that they are expected to learn how to participate in a scientific discourse (Jiménez-Aleixandre et al., 2000). Such difficulties can be understood in terms of difficulties with acquiring the recognition rules for a particular classroom context, which guide students in their attempts to put meaning together in ways that can help them reach the goals of a curriculum, and eventually, education (Bernstein, 1981). In particular, classroom practices with weak boundaries between discourses present even greater challenges for the students to acquire recognition rules (Morais et al., 1992). Our results should be understood in the context that language reflects cultural background, and important differences exist among students and student groups with regard to their recognition of what discourses are appropriate to use in a science classroom and, in particular, an SSI classroom.

Our results revealed that students exhibiting successful recognition of the educational demands of SSI environments are amenable to integrate different perspectives by allowing weak boundaries between discourses, using both particularistic and universalistic meanings. In contrast, students who are not guided by recognition rules for the educational demands keep different perspectives isolated from each other by upholding strong boundaries between different discourses as well as between universalistic and particularistic meanings.

Below, we first discuss the characterization of students' successful and unsuccessful recognition for producing an SSI discourse. This is done by discussing: (i) students' successful recognition as indicated by weak classification of discourses, and how a dynamic use of universalistic and particularistic meanings can support meaning-making of a variety of discourses; and (ii) students' unsuccessful recognition as indicated by strong classification between discourses, and how a nondynamic use of universalistic and particularistic meanings seems to inhibit an SSI discourse. We also tease out the theoretical and pedagogical implications of our findings.

7.1 | Students' successful recognition is indicated by weak classification of discourses and dynamic use of universalistic and particularistic meanings

Rules for talking science in the traditional content–knowledge-focused science classroom are to a large extent acquired implicitly (Lemke, 1990). In classrooms with weak classification between discourses, where for example school and nonschool discourses are invited, rules are typically much more challenging for the students to acquire (Bloomer, 1998; Whitty et al., 1994; Young, 2008). However, in the present study, students in one of the groups were guided by recognition rules that allowed them to make use of a variety of discourses in such a way that they could produce sustained SSI discourse. This was observed by their maintaining a weak classification of discourses, thereby allowing for a more robust integration of discourses representing multiple perspectives into their discussion. For example, they integrated everyday discourse with school discourse, and they included
opposing positions into their reasoning on the wolf issue to produce a collective understanding without necessarily taking a stance. In doing so, they were able to engage in a discussion similar to what has been described as exploratory talk (Evagorou & Osborne, 2013; Lewis & Leach, 2006; Mercer, 1996) and socioscientific reasoning (Sadler et al., 2007). Their use of both everyday discourse and school science discourse can be viewed as if they created a third space (Moje et al., 2001). Hence, students from one group in our study seem to have acquired the recognition rules for an SSI discourse (i.e., to produce a discussion allowing for weak classification), which is a prerequisite for an SSI discussion where complex and nuanced understandings of the issue are developed. In the study by Evagorou and Osborne (2013), the authors point out that explorative talk and sophisticated formal arguments are typical for high ability students (i.e., students who have acquired the rules for classroom talk). Our study adds to the aforementioned in the sense that we attempt to provide further understanding as to how students’ ways of communicating allow for the integration of discourses in an SSI discussion.

In the successful student group, the students were observed making use of universalistic and particularistic meanings in a dynamic manner to produce a complex and nuanced SSI discussion. Students either made use of universalistic meanings from different discourses or produced universalistic meanings based on particularistic contexts, such as personal opinions. This dynamic use of meanings can be described as using universalistic meanings entailing abstractions and principles, derived from particularistic meanings, thereby allowing the students to navigate seamlessly between particularistic meanings of different positions as well as perspectives. This way of reasoning has similarities with General considerations (Berland et al., 2016) in students’ scientific reasoning. By way of generalization, students can build models for scientific phenomena that enable sophisticated meaning that in turn can be used for understanding new observations. However, in an SSI discussion, the students have the challenge of making generalizations of claims from a variety of discourses besides the scientific discourse. The universalistic meanings expressed by the students in the present study could be considered, to some extent, analogous to backings (i.e., principles or generalizations) that make warrants trustworthy as found in TAP (Toulmin, 1958). In the context of the present study, the universalistic meanings can occur as backings to warrants as well as rebuttals. Our interpretations show that when students decontextualize their presented knowledge, they can widen the discussion by allowing negotiation of aspects from content knowledge as well as personal opinions and emotions. As a result, students can develop both decontextualized and contextualized understandings when using universalistic and particularistic meanings in a dynamic manner. Hence, in the present study, we do not distinguish between warrants and rebuttals, but rather how they were used in relation to particularistic and universalistic meanings. According to Osborne et al. (2004), warrants and backings are considered as belonging to intermediate level arguments, and rebuttals to higher and more sophisticated levels of complexity. Yet, unless students focus on relevant science content knowledge, the complexity of other dimensions, for example, values and emotions, usually means additional aspects, such as multiple dimensions and perhaps perspectives (see Evagorou & Osborne, 2013; Grace, 2009; Sadler & Donnelly, 2006). This suggests that the abstractions used in science are more available to students or seem more appropriate in a science classroom. Hence, we claim that the dynamic use of universalistic meanings, including backings to warrants or rebuttals are crucial for successful SSI discussions, because they appear to be necessary for negotiating not only claims from a science discourse, but also claims from other discourses. By making generalizations that allow negotiation between discourses on a decontextualized level, new meanings are made that can be used to understand contextualized observations. Thus, multiple perspectives can be integrated into the discussion, making the complexity of the issue more accessible for an eventual decision-making discussion.
Students' unsuccessful recognition is indicated by strong classification between discourses and nondynamic use of universalistic and particularistic meanings

When challenged with a classroom practice exhibiting weak classification, all but one of the student groups kept strong boundaries between everyday and school discourses. As a result, the inclusion of multiple perspectives was inhibited. Students' making strong classification between discourses was interpreted as a way to reject or avoid giving relevance to discourses. This was exemplified by students: (i) producing (rote) answers to the teacher's question; (ii) rejecting the relevance of the particular SSI task; or (iii) exchanging personal opinions.

Unsuccessful recognition in terms of aiming to produce answers to what seemed to be the teacher's question effectively keeps nonschool discourses as well as non-science discourses out of the discussion. Students tend to keep to the traditional “norms” of a science classroom where facts appear nondisputable, as also reported by others (Berland & McNeill, 2010; Driver et al., 2000). Although progressivist ideas have enriched teaching practices in the last few decades, strong classification is still common in education (Whitty, 2010; Young, 2008) among teachers as well as students. This is particularly true in the science classroom, where disciplinary discourse is the rule for talking about actualized phenomena (Moje, 1995), something that can be understood in the authoritative interaction (Scott et al., 2006) through the initiate–response–evaluate (I–R–E) pattern (Mehan, 1979). Consequently, it is reasonable to expect students to be guided by previously acquired discursive rules and subsequently lack recognition rules for new contexts (Ivinson & Duveen, 2005), such as an SSI context. Apparently, students who are not sensitive to the new demands fail to perform as expected of them. This is where carefully crafted pedagogy and familiarity with the underlying rationale of SSI practice becomes paramount.

Students in the present study were also found to reject the relevance of the SSI task. This appeared as their refraining from negotiating critical aspects of the SSI by referring to: (i) authorities; or (ii) the problem not affecting them personally. In both cases, the students kept school discourse apart from (i) nonschool, usually from a universalistic position, or (ii) their everyday discourse (a particularistic perspective). The problem of not engaging in socioscientific reasoning by referring to authorities has been highlighted in previous research (Lindahl & Lundin, 2016; Kolstø, 2001; Sadler et al., 2007), and the problem of limited reasoning in an SSI context has been raised by others (Grace, 2009; Ratcliffe, 1997), suggesting that such problems can be ameliorated by scaffolding through structured prompts as well as by building decision-making strategies (Gresch et al., 2013). In the present study, unsuccessful recognition was evident by the students keeping strong boundaries between school discourse and other discourses, thereby effectively preventing the negotiation of meanings from the multiple perspectives related to the SSI at hand. Hence, scaffolding beyond structured prompts is needed to promote SSI discourse.

The students in our study were also found to keep strong boundaries between their personal everyday discourses (i.e., particularistic meanings). They did not appear to be familiar with how to engage in meaning-making of everyday meanings in an explorative way. Hence, they did not seem to have recognition rules for building knowledge by negotiating personal opinions. Instead, they merely kept to exchanging personal opinions in a manner that inhibited their understanding of others’ perspectives. As shown by others, students have difficulties with overcoming their personal narrative (Evagorou et al., 2012) and often refer to a personal opinion without developing the argument further (Sadler & Donnelly, 2006). This is problematic because personal opinions are important to integrate into the SSI discussion with regard to student engagement and eventual further understanding (Sadler et al., 2007; Zeidler & Sadler, 2008). When the students in the present study maintained strong boundaries between discourses, unrealized by the teacher or themselves, this hampered a seamless
integration of everyday discourses into the SSI discussion, such as their personal beliefs. This also means that the beliefs or perspectives of others may not become viable candidates for consideration by students or groups using strong classification. Although sensitivity toward others' opinions can increase over time to some degree (Fowler et al., 2009) with proper teacher guidance, an unchecked reluctance to consider others' views may prevent students from engaging in more sophisticated socioscientific reasoning, because they fail to examine the issue from multiple perspectives or recognize the complexity of the issue (Sadler et al., 2007). Based on the results in the present study where students' strong classification between discourses, as well as between universalistic and particularistic meanings, prevented the integration of discourses into the discussion, their apparent misunderstanding of the educational purpose of the task can be explained as either their lack of recognition regarding what to say and how to say it in the classroom (Bernstein, 1981; Lemke, 1990), or that they did not receive sufficient scaffolding regarding procedures for group discussion (Evagorou & Osborne, 2013; Grace, 2009; Ratcliffe, 1997) and explicit instructions on how they were to make use of the different discourses (Morais & Neves, 2001).

In general, when the students used strong classification of discourses, it seemed to inhibit more complex and nuanced SSI discussions, especially because universalistic and particularistic meanings were kept apart. Without a dynamic movement between universalistic and particularistic meanings, students were unsuccessful in producing an integrated discussion to build a collective understanding using a multitude of discourses. Instead, they would refer to authorities, a pattern also described by Nielsen (2012). In doing so, they used universalistic meanings to reject the arguments or opinions of others. Also, particularistic meanings, such as personal opinions and emotive arguments, were used to reject other perspectives. Although students' patterns of informal reasoning (intuitive, rationalistic, emotive), as described by Sadler and Zeidler (2005), were present, those forms of reasoning could not be integrated into the discussion in a constructive manner. Apparently, personal opinions and emotions were kept apart from and were given precedence over universalistic meanings in such a way that the building of a collective group understanding was hindered. Hence, universalistic and particularistic meanings were kept apart in a manner that prevented robust SSI discourse.

8 | THEORETICAL IMPLICATIONS

The finding that successful integration of different discourses could be described in terms of a dynamic use of universalistic and particularistic meanings is important for understanding SSI discourse. Bernstein's theoretical model attempted to describe why some students were unsuccessful throughout their education in a traditional school system with strong classification and framing. Our study expands on his model by (i) using a progressivist context, and (ii) by focusing on how students' discursive actions at the student-group level can be understood in terms of Bernstein's theoretical concepts. We show that students with successful recognition navigate seamlessly between universalistic and particularistic meanings of different positions and perspectives. This approach is compatible with elements of scientific reasoning. In particular, it allows students to generalize from observations as well as how to use generalizations in support of specific cases (Berland et al., 2016). By integrating this dynamic approach to reasoning, the use of TAP in conjunction with different reasoning patterns could be useful to further the understanding of the qualities of students' reasoning, whether in spoken or written form.

One important reason for giving more attention to universalistic meanings is that an overemphasis on everyday experiences provides few opportunities to consider other broader contexts in relation to the value of the students' own experiences. This could be problematic because both universalistic and
particularistic meanings are needed to produce an understanding about values derived from different contexts. To emphasize further the role of universalistic meanings, on the basis of our results, we have constructed a model (Figure 1) that captures how decontextualization and contextualization of additional discourses can function as the crucial piece for maintaining an SSI discourse. When students have recognition for the curricular goals of an SSI classroom, they bring different discourses to bear into the discussion (Discourses X and Y in Figure 1). Discourses can be introduced in a decontextualized (universalistic) or contextualized (particularistic) manner. Contextualized discourses can be decontextualized and vice versa (vertical arrows on opposite sides in Figure 1). This is an important process because decontextualization brings out generalized (universalistic) understandings that can deepen the understanding of the specific discourse, and a subsequent recontextualization can give more meaning to the specific discourse in its context. However, for a successful SSI discourse, it is crucial to break away from keeping discourses apart by merely exchanging or rejecting discourses. For a successful SSI discourse, the most important feature is the appraisal and negotiation of different discourses. This is accomplished by the appraisal and negotiation of decontextualized

![Diagram](image)

**FIGURE 1** Model displaying routes for successful and unsuccessful SSI-discourse. The decontextualized discourses in the upper part of the model are more abstract and generic than the contextualized discourses in the bottom part. Negotiation of decontextualized discourses allows decontextualized understanding that can be recontextualized for contextualized understanding and modification of contextualized discourses. To put the model in the context of the study the following introductory examples can be given: Decontextualized X: “Wolves are a threat to the public…”; contextualized X: “Suppose you get chased by a wolf on your way home from school.”; decontextualized Y: “All animals have a right to exist…” (would only be present in successful SSI-discourse); contextualized Y: “I think we should have wolves.”
discourses, which can result in an understanding of the different discourses on a general (decontextualized) level (upper center arrow in Figure 1). Decontextualized meanings enable access to the explicit understandings derived from different contexts, such as those of the group members. Appraisal and negotiation of different knowledge and values then becomes possible, as does the awareness of others’ ways of reasoning. Such understandings of other's ways of reasoning can then be recontextualized and promote the understanding and possible modification of the initially conflicting perspectives based in different contextualized discourses (second lowest center arrow in Figure 1). In this manner, an informed personal decision-making can then be the result of a recontextualization of an understanding based on the appraisal and negotiation of decontextualized meanings. If students do not engage in an appraisal and negotiation of decontextualized meanings, they will be restricted to comparing contextualized discourses (bottom horizontal arrow in Figure 1). By comparing two contextualized discourses (X and Y), the knowledge and values conferred by the discourses are only implicitly compared and cannot by themselves result in an informed decision, but rather in exchange of opinion or even rejection of discourses. Comparing contextualized discourses, with little or no negotiation of knowledge or values, is typical of students who engage in an unsuccessful SSI discussion. Although meanings in an unsuccessful SSI discussion are occasionally decontextualized or (re-)contextualized within a single discourse (e.g., Discourse X in Figure 1), this is only to strengthen statements and not a foundation for appraisal and negotiation. Students who do not have recognition for the educational demands resort to mainly comparing discourses that are based on their implicit knowledge and values.

9 | PEDAGOGICAL IMPLICATIONS

Students’ potential to understand what is expected of them appears to be dependent on teachers’ explicit communication of evaluation criteria (Morais & Neves, 2001). Although such communication may have its weaknesses, our results highlight the necessity for all students to be given opportunities to understand the curriculum expectations that can guide working with an SSI task. Our contribution is to point out the necessity of being aware that different recognition difficulties can be expected in a seemingly homogeneous student group. We agree with other researchers (Duschl & Osborne, 2002; Ratcliffe, 1997) that structuring prompts adapted to their level of performance and in a proportional number, can be helpful (Berland et al., 2016; Osborne et al., 2004). For example, prompts such as the guiding questions used in this study provide a degree of structure, affording students the opportunity to focus on and address the task at hand, while maintaining ownership of the particular content they value and wish to advance. However, students also need to be reminded of the curricular goals, especially when introduced to a new classroom context with new discursive rules. Otherwise, they will remain unaware of the overall learning goals beyond the task and, as we have shown, misinterpret guiding prompts as well as the purpose of an activity, such as a group discussion. This becomes particularly important given the trend to include discourse, argument and debate in content-specific courses that make use of sociocultural pedagogical approaches in science education (Herman, Sadler, Zeidler, & Newton, 2018; Karisan, Yilmaz-Tuzum, and Zeidler (2018); Owens, Sadler, and Zeidler (2017). The role of the teacher then is to provide easily understandable prompts, sequenced in a manner that gradually guides students through the increasing complexity of an SSI task, while focusing the students’ attention on the production of knowledge in accordance with the curriculum goals.

Our suggestion regarding instructional sequencing is that the students should start by describing the positions of the stakeholders in the public debate and how they relate to each other in order to
facilitate taking different positions (one's stance on an issue), orientations (one's approach to an issue in relation to others), and perspectives (one's perception and interpretation of the issue; see Kahn & Zeidler, 2016a, 2016b), before they start to express their personal opinions. In doing so, perspective taking can be facilitated, for example, through role playing, allowing students to shift between etic and emic perspectives (Kahn & Zeidler, 2016a). This facilitates additional universalistic and particularistic meanings to be actualized as students compare the different positions. Because our study points out the problem of students' keeping strong boundaries between the different discourses in an SSI classroom, we suggest the following. Before and during group discussions, the students may need scaffolding from the teacher to: (i) distinguish between universalistic and particularistic meanings and how they impact on the orientation of positions; (ii) move between particularistic and universalistic meanings in order to produce new meanings together as the students compare actualized positions; and (iii) appreciate and formulate a variety of possible meanings in order to develop their perspective taking related to an SSI, instead of focusing on the traditional school discourse to find one right answer. This is consistent with the work of Yoonsook et al. (2016) who empirically demonstrated how SSI instruction contributed to students' communication skills through the weak framing of issues, allowing them to develop a better understanding of others' key ideas, value others' perspectives, and develop active assertions. Since it has also been shown that explicit communication of evaluation criteria promotes learning when the framing is weak (Morais & Neves, 2001), these scaffolding can also be used in written form as recurrent comments to students in the process of writing argumentative texts. Based on our findings, these suggestions should aid in eroding the pedagogical barriers that stand in the way of students' acquisition of recognition rules for a progressivist classroom and make explicit the pedagogy and rationale associated with it.

10 | LIMITATIONS

One limitation of this investigation is that this is a small case-study and subsequently additional categories of unsuccessful recognition may have been undetected but could be described in further research. Another limitation, at least on a theoretical level, is that the number of excerpts that were interpreted as “deviating from the focus of the task” was relatively small (4). This is potentially important because it is necessary to discern a students' attitude toward the task from their ability to actually engage in the task. For example, a student may be disinterested in the task, lack basic understanding, lack construal, and recognition of the task, or have the intellectual prerequisites to understand and carry out the task but not the motivation or social maturation to apply themselves to it. However, in practice, it would be a quite useful from the teacher's perspective to properly understand “deviation from the focus of the task” as unsuccessful recognition, because then the teacher is afforded the opportunity to respectfully address the student's issue while supporting learning without degrading confrontation. Therefore, this category may need to be more fully parsed and articulated. Although Bernstein's theory is well suited for studying recognition rules, which is a prerequisite for successful learning, it does not provide opportunities to assess students' learning or attitudes toward education—aspects that are both important and relevant in the situation studied. Such limitations mean that explanations for the outcomes of students' behavior are beyond the scope of this study.

Another limitation is that we describe the work in one single classroom using a teacher with practical and conceptual knowledge of the SSI framework. This reduces the external generalizability of the study because novice teachers may find it more difficult to encourage students to engage in discussions using weak boundaries between discourses. Furthermore, it is important to note that the Swedish national curriculum for “Science Studies” can be interpreted rather freely giving teachers
much flexibility in organizing pedagogical approaches having both weak framing and classifications. However, this limitation can also be regarded as strength because it makes this classroom suitable for study because weak framing and classification is likely to challenge students’ interpretive skills to acquire recognition rules for a progressivist classroom. The students' previous experience of lower secondary school had comparably much stronger framing and classification than that of the studied classroom. Such contrasts could imply that our case-study is rather unique, but also that it brings out students' difficulties in a manner that well suits the aim of our study. Again, however, it is likely the case that most students' experiences have been derived from essentialist modes of instruction and will face the same tensions in understanding the demands of classrooms that stress SinC.

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ORCID

Mats G. Lindahl  https://orcid.org/0000-0001-9132-8615

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