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Signs of taste for science: a methodology for studying the constitution of interest in the science classroom

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Abstract In this paper we present a methodological approach for analyzing the transformation of interest in science through classroom talk and action. To this end, we use the construct of *taste for science* as a social and communicative operationalization, or proxy, to the more psychologically oriented construct of interest. To gain a taste for science as part of school science activities means developing habits of performing and valuing certain distinctions about ways to talk, act and be that are jointly construed as belonging in the school science classroom. In this view, to learn science is not only about learning the curriculum content, but also about learning a normative and aesthetic content in terms of habits of distinguishing and valuing. The approach thus complements previous studies on students' interest in science, by making it possible to analyze how taste for science is constituted, moment-by-moment, through talk and action in the science classroom. In developing the method, we supplement theoretical constructs coming from pragmatism and Pierre Bourdieu with empirical data from a lower secondary science classroom. The application of the method to this classroom demonstrates the potential that the approach has for analyzing how conceptual, normative, and aesthetic distinctions within the science classroom interact in the constitution of taste for, and thereby potentially also in the development of interest in science among students.

Keywords Interest · Taste · Aesthetics · Science education · Situated learning · Norms · Values · Methodology

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Svensk sammanfattning I denna artikel presenterar vi en metod för att studera hur intresse för naturvetenskap utvecklas i klassrumssituationer. Vanligtvis har man förstått och även studerat intresse för naturvetenskap som en personlig egenskap med stor betydelse för hur elever uppfattar och lär sig saker i klassrummet. Elevens intresse för ämnet kan i sin tur påverkas positivt eller negativt av undervisning. Intresse för naturvetenskap handlar inte enbart om attityder till ett ämnesinnehåll, utan även om hur eleven uppfattar de värden och normer som verksamheten uttrycker; är detta någonting jag kan identifiera mig med och vill vara del i? Intresse har därmed också en normativ dimension som handlar om huruvida eleven kan och vill delta i praktiken, dels i den aktuella klassrumssituationen men också i framtida naturvetenskapliga sammanhang. Även om ovanstående är välkänt vet vi förvånansvärt lite om sammanhangets betydelse för hur ett intresse för naturvetenskap skapas och utvecklas. Metoden som presenteras i artikeln är ett svar på ovanstående. Vi visar här hur *smak* kan användas för att studera hur intresse konstitueras genom tal och handlingar i sociala interaktioner. Att ha smak för någonting, till exempel klassisk musik eller korpfotboll, innebär inte enbart att man på en direkt fråga svarar att man tycker om eller är intresserad av fotboll, man kan även delta i sammanhang där kunskap om fotboll uttrycks och värderas. Att få smak för skolans naturvetenskap innebär därmed att utveckla vanor för att uttrycka och värdera distinktioner gällande hur man talar, handlar och är i naturvetenskapsklassrummet. Då smak uttrycks genom hur vi i sociala interaktioner urskiljer vad som är rätt och fel, fint och fult och så vidare, är smaken därför också möjlig att observera i handling. Vid utvecklandet av metoden använder vi oss av teori från Pierre Bourdieu och pragmatism för att analysera hur smak urskiljs i ett högstadieklassrum. Genom det empiriska materialet visar vi hur metoden kan användas för att synliggöra hur kognitiva, normativa och estetiska urskiljningar interagerar när smak konstitueras i klassrummet. Vi visar även hur detta har betydelse för utvecklandet av ett intresse.

Svenska Nyckelord Intresse · Smak · Estetik · Normer · Värden · Naturevetenskap · Metodologi

The backdrop for this paper is the large body of knowledge on students' interest in science. Because most of this knowledge is based on reports from students about their experiences of science and science education (Osborne, Simon and Collins 2003), using psychologically oriented constructs and methodologies (Krapp and Prenzel 2011), there is a need to study also more directly how interest in science is constituted through classroom interactions. The aim of this article is to develop such a methodology. To reach this aim we use the concept of *taste* as an operational proxy for the more psychologically oriented term *interest*. As will be demonstrated in the paper, having taste does not designate merely an affective state of mind, but covers also cognition, values, and norms—aspects recognized to be of great importance for peoples' possibility to engage in social practices (regarding science education, see e.g. Carlone, Haun-Frank and Webb 2011). A taste for classical music, for example, is not simply an emotional state, but results from continuously learning cognitively, aesthetically, as well as normatively as part of social settings. Hence, for instance having a taste for classical music does not mean merely reporting that you enjoy classical music, but entails that you can engage and take part in classical music communications by making certain distinctions through talk and action. Here we adopt such a socially situated approach to develop a methodology to analyze the constitution of taste within the field of science education.

Our approach is based on a combination of pragmatically oriented research on aesthetics and taste in science education (Wickman 2006) and Pierre Bourdieu's work on taste in different fields of French society. Although Bourdieu (e.g. 1984) demonstrated that taste is constituted through people's upbringings and education, it is not a static condition but something which is constantly transacted as part of situated activity. Since people's taste becomes visible from what they say and what they do, taste can be observed in action. In this way the concept makes it possible to study how the teaching and learning of the conceptual content of science and the learning of its norms and values are made continuous. Since learning science is at once a social, cognitive, aesthetic, and normative enterprise (Wickman 2006), Bourdieu's findings regarding taste should be relevant for the enterprise of moving the study of the development of interest in science in closer contact with the moment-to-moment interactions within the science classroom. Taken together, the methodology that we present makes it possible to empirically examine the consequences of various types of classroom interactions for the development of taste for science, thereby contributing to the field of students' interest in science.

The concept of interest

Interest in science has been extensively studied by the science education research community (Bybee and McCrae 2011). The background for a majority of the studies is the reported decline in students' interest in science in Western countries, whether seen through specifically designed questionnaires or through students' post-compulsory career choices. Research has also been motivated by the importance that attitudinal factors may have for cognition and, therefore, for learning science (Drechsel, Carstensen and Prenzel 2011). The findings point to a long list of various factors significant for student interest, as for instance gender, school context, age, personality of the teacher, type of instruction, socio-economic background, and student counselling (Tytler, Osborne, Williams, Tytler and Cripps Clark 2008).

In these studies it is not always apparent what kind of interest the findings actually refer to, which is a recognized dilemma in the field (Osborne, Simon and Collins 2003). This ambiguity can in part be explained by different methodological approaches, but also by the vague operational meaning of interest (Blalock, Lichtenstein, Owen, Pruski, Marshall & Toepperwein 2008). In some studies interest is one of many internal entities affecting motivation, whereas in others, interest is equivalent to motivation or other attitudinal concepts (Krapp and Prenzel 2011). Furthermore, interest can be intrinsic or extrinsic, individual or situational, and domain or subject specific (Koballa and Glynn 2007). Finally, interest is usually conceptualized as caused by affective and cognitive factors (Hidi, Renninger and Krapp 2004) and, thus, primarily studied as mental and personal rather than embodied and socially shared.

At the same time, several studies show that interest in science not only refers to attitudes to the conceptual content, but also to the scientific norms and values as they are projected through its practice in the science classroom (Taconis and Kessels 2009). Leif Östman (1994, 1998) argued that apart from the intended curriculum content, there are always so-called companion meanings to be learnt, which convey moral lessons about the relationship between the student and science, as for example: Do I belong here? or Is science for me? Hence, students never learn only the science content, but at the same time also how to articulate and relate to the norms and values of the practice (Jakobson and Wickman 2008), that is, to participate by talking and acting science (Lemke 1990). We therefore argue that cognitive, normative, and aesthetic distinctions have to be examined alongside each other when studying the constitution of interest in science.

In their review on research on interest in science, Krapp and Prenzel (2011) show that the interactions that is taking place between students and between teacher and students may have significant consequences for the constitution of interest in science. The findings are however primarily based on interviews, questionnaires or rating scales (Krapp and Prenzel 2011). As a consequence, we know little about the situated constitution of interest (Abrahams 2009). There is thus a need to develop methodologies to study the constitution of interest in situ through teaching and learning (Abrahams 2009). Only by using such methods is it possible to examine how teaching can make a difference for students' interest in science which, of course, is of central concern to science education. Indeed, methods that make us better equipped to understand how the actual classroom transactions influence students' interest should be helpful to science teachers. Developing such methodologies, however, demands a more action-oriented concept than *interest* to make it possible for researchers and teachers to observe this constitution in the classroom. In this paper we argue that *taste* can be used for such a purpose.

The concept of taste

Bourdieu (1984) demonstrated that taste, which is learnt and embodied through upbringing and education, is associated with different social groupings and settings. Being socially situated, aesthetic and normative judgments on phenomena such as politics, art, music, sports, or food-dishes are of great importance when participants in various social groups distinguish themselves in relation to other groups. Taste may thus affect the extent to which people are successful in, and also are given access to, different practices. In academic settings, for example, the autodidact is usually not recognized as an equal just because he distinguishes himself as an autodidact (Bourdieu 1984). In the academic practice you not only learn a content, but also what actions and phenomena this environment recognizes as interesting or not, good and bad, nice and ugly, and so forth (Bourdieu 1984). The science classroom has been described as a specific practice with certain values and norms (Aikenhead 1996) and also here numerous unquestioned distinctions are made about what is good or bad practice (Wickman 2006). Students are often reported to describe this normative practice in stereotypic and negative aesthetic terms: the right explanation dominates science practice, science is for the smart kids, science is a male practice, and so on (Brickhouse, Lowery and Schultz 2000).

Considering that the culture of school science involves normative expectations that often seem to conflict with the values of students, it has been argued that many students may experience the science classroom culture too alien to engage in (Taconis and Kessels 2009). This is supported by the finding that cultural background, such as social class and gender, influences the extent to which students take up a scientific career (Adamuti-Trache and Andres 2008). At the same time, there are indeed schools which succeed in counteracting the cultural background of their students, in that a larger proportion of students than expected choose a post-compulsory science career (Anderhag, Emanuelsson, Wickman and Hamza 2013). This suggests that we need to look into classrooms more closely.

It is likely that in order to develop a taste for science, students need to learn what distinguishes it, how its distinctions are made, how you are distinguished by others in its activities, and whether you are able to, want, or even like to take part in it. This means meeting the science content of the classroom, not only in terms of concepts as representations, but also in terms of inclusions and exclusions of objects and actions, as well as the normative and aesthetic judgments used in making these distinctions (Wickman 2006). Consequently, to acquire a taste for science does not only mean that you learn to enjoy science but also that you develop a familiarity with, and competence in, how distinctions are valued in this practice in terms of talking, acting, and being. In a more general societal context than science education, Bourdieu (1984) described this development of taste as transformation of a person's *habitus*. The habitus is a person's learnt and embodied habitual ways of acting. These dispositions, which are a result of upbringing and education (in their broadest sense), have consequences for the person's potential to participate in different activities. According to Bourdieu (1984) your taste, which is an important part of your habitus, is how you make distinctions. The distinctions you make in relation to practices involving politics, food, movies, literature, sports, science, and so on are what make up this taste. Thus, taste becomes visible through our distinctions, which are the choices of actions and the judgments we make in dealing with people and things as part of practices. At the same time, other people are judging us according to the distinctions we make.

All through his book *Distinction*, Bourdieu (1984) repeatedly emphasized that his empirical findings on taste should not be seen as static, but as continuously relational, varying and changing through space and time. But although Bourdieu theoretically acknowledged the continuous constitution of taste, empirically he studied taste as an already constituted structural component of society rather than its actual constitution in situ. However, recent developments of Bourdieu's thinking call for an extension of his structuralist oriented empirical work by studying also how habitus is actually transacted as practice (Albright and Luke 2008). For this reason we supplement his findings with pragmatist theories and methods for studying meaning-making as situated (Wickman and Östman 2002). Indeed, as acknowledged by Bourdieu himself there is a close relationship between John Dewey's concept of *habit* and Bourdieu's concept of *habitus* (Bourdieu and Wacquant 1992). In both frameworks the two concepts are used as embodied operationalizations for dispositions of action (cf. Bourdieu 1998; Dewey 1922). According to Dewey, people develop certain tastes by taking part in already existing human institutions and customs (e.g. Dewey 1929/1984). Distinctions of taste are not necessarily actions made intentionally, neither are they arbitrary. Rather, they are the ways people can be seen to act. Taste is a set of habits resulting from lived experience and, therefore, should be understood as something that can be seen when transformed in use. In this way taste is continually transacted and at stake and, so, visible for inspection. This is also the operational definition of taste that is used in this paper.

Any methodology needs to be grounded not only theoretically but also in empirical data (Glaser and Strauss 1967). The analytic framework that we develop in this paper is therefore applied to conversations recorded in a secondary science classroom. The purpose is to illustrate how the framework may help in the description and analysis of the constitution of taste in the conversations and activities of science education.

The study setting

Since our aim is to develop a methodology for studying the constitution of taste in classroom settings, we needed to find a school where positive instances of this could be found and where the teaching and not only the students' socio-economic background contributed to their development of taste for science. For this reason we used statistics from the Swedish National Agency for Education and Statistics to locate a suitable lower secondary school (grades 7–9). We actively searched for a school (a) where a comparatively high proportion of the students recurrently apply for the Natural Science Program in upper secondary school, and (b) where the student population of the school has a heterogeneous socio-economic background. The school chosen qualified in both these respects. Over a 2 year period 25 % of the students of this school, applied for the natural science program, as compared to the national mean of 15 % for the same period. In Sweden the students choose upper-secondary programs during the ninth grade. The Natural Science Program is the upper-secondary school program with a natural science profile and is preparatory for tertiary academic studies.

Educational career choices and/or subject enrolment sometimes are used as signs of interest in science (Osborne et al. 2003). At the same time, studies have shown that variables such as socio-economic background and educational level of the parents are important for selecting the natural science program in Sweden (Anderhag et al. 2013) as is the case in many other countries (The Royal Society 2008). In schools with children from affluent socio-economic backgrounds and with well-educated parents it is likely that it is the home, rather than the school, that influences the students' choice. Therefore we cannot assume that a high application frequency to post-compulsory science programs automatically means that this particular school cultivates a student interest in science. On the contrary, application frequency above mean could actually be less than expected considering the socio-economic setup of the student population of the school (Anderhag, et al. 2013). However, in the school of this study, variables correlating to cultural capital gained from upbringings at home cannot explain the high proportion of students choosing the natural science program. For example, although being a complex parameter, during the sample period 29 % of the students had immigrant background which is higher than the national mean during the same period of 18 %. Parental educational level is clearly associated with the choice of the NSP (Anderhag et al. 2013), and during the sample period, 50 % of the students at the school had parents with tertiary education. This is slightly less compared to the national mean of 51 %. Since the socio-economic status of the studied students are about average or even somewhat less than average, and since a proportion well above average chose the NSP, it appears likely that the teaching in this specific school play at least some role in this school's high recruitment rate. Notwithstanding that this deviation is interesting in its own right, our intention was not to make any closer examination into why the students choose post-compulsory science to the extent they do. Nor was our intention to draw any general conclusions regarding the teaching in science in this classroom. As mention above, the reason for that we ultimately decided to make our study at this school was because here we were likely to find relevant classroom data that could illustrate the theoretical constructs. Hence, this school was chosen, because we expected to see positive instances of a taste for science being constituted. A class where students systematically turn away from science education activities would be of little help for our aim. We also decided to choose a lower secondary science class, because this is the age when students are reported generally to "lose" their interest in science (e.g. Tytler et al. 2008), and which thus is an age-group that should be of great interest for future studies within this area. The data for this study comes from a seventh-grade physics class (students about 13 years old). The school is a public K–9 school located in a suburb to Stockholm. In this school there are three science teachers for grades 7–9, one in each of the subjects biology, chemistry, and physics.

The class, with the home background composition discussed above and with an even mix of boys and girls, was filmed and audio recorded during one physics lesson. One camera followed the experienced female teacher as she visited and interacted with the different lab groups. The recordings were transcribed verbatim and analyzed for situations where students actively made distinctions (see below). The excerpts presented in the paper are illustrative representations of the taste constructs found in the material. The video data served as analytical cues clarifying non-verbal interactions such as actions, gestures, and expressions. This data thus assisted us in the interpretation of aesthetic judgments; occasionally it was for example necessary to review the filmed material to determine whether an utterance was a joke or an ironic remark. The video material was also used to interpret students' emotions and feelings when making aesthetic judgments.

Even if this is not a study of this classroom as such, some details of the classroom setting are necessary to present in order to understand how the methodology can be used to analyze data. The lesson was chosen because the students had ample opportunities to interact in speech and with materials. The aim of the lesson was to introduce, and for the students to use, formulas and methods to measure the volume of different objects. This activity was part of a unit in which different aspects of matter (e.g. being measurable), was treated. The project spanned over seven lessons and the activity observed was the second of three lessons focusing on volume. Figure 1 (based on Kelly and Chen 1999) describes how this lesson was situated in relation to the other lessons, projects and science units of the academic year.

During the introduction of the activity the teacher clarified for the students that during this lesson they were going to collaboratively measure the volume of different objects, and; the objects measured should be named according to their characteristics (e.g. the *small* and the *big* weight). Through her verbal and written introduction the teacher carefully, step by step, described what students were supposed to do and find out during the lab. Besides the practical aspects of measuring objects, she also stressed how this assignment should be carried out, which is illustrated through the following excerpt:

1. Teacher: Are you ready? Can we start? There are a lot of things that I've drawn on the board today. Explanations on the things you're supposed to use. Last week you did a lab on electricity. Tested which material that conducted electricity and which did not and you did a really great job. Today there're different materials on the desk. And what I especially look at is how you collaborate. If you talk to each other when you do the things, so that there's not only one person who does all the stuff, but that you jointly help each other so there will be good results. Now you're going to measure the matter that is on the table. What kind of matter do we have on the desk? Last time we talked a little about matter. Susanne?
2. Susanne: Wood
3. Teacher: Wood is lying on the table, yes precisely. What else are there?
4. Peter: Weights
5. Teacher: There are also weights on the table. What material are they made of?
6. Peter: Like some kind of iron
7. Teacher: Some kind of iron. Like some kind of metal.

During the introduction and also during the practical part of the lesson, the teacher recurrently made distinctions with reference to collaboration and naming. Besides telling the students that she would pay special attention to whether they helped each other, collaboration was also judged as something that was leading to good results. In this activity collaboration was thus distinguished as the preferred way of doing lab work and during the practical the teacher often returned to this aspect of doing inquiry. The students, who clearly enjoyed the activity, worked in groups of three measuring the volume of cylinder-shaped metal weights and cubes of wood. They used beakers and graduated cylinders to measure the change in water volume, when they lowered the weights into them. During the lesson the students jointly had to make sense of a diversity of issues in order to be able to carry out the assignment: they needed to find suitable names for the objects they were about to study, decide on which glassware to use, calibrate and understand the scale on the

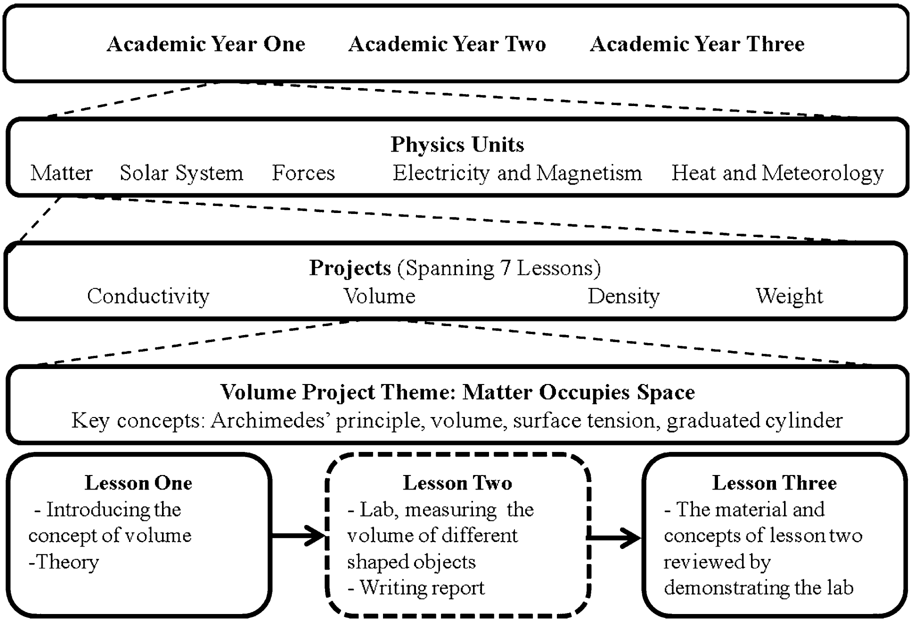

Fig. 1 The place of the recorded "Lesson Two" in the Volume Project as situated in the first academic year of lower secondary school (Grade 7)

graduated cylinder and so on. During the practical the teacher helped the students carry out the tasks mentioned above as she constantly moved between the different student groups.

Developing the methodology

The aim of this paper is to present a methodology for studying the *constitution* of taste in science classrooms. Clearly, acquiring taste for science amounts to a continuous and social process where cognitive, aesthetic and normative aspects of participating in science practices become embodied as habits. Viewed in this way, the development of taste for science is understood as the potential consequence of an inclusive and gradual process in which the student learns how actions, words and ways-to-be are distinguished as parts of a practice. However, we contend that irrespective of the actual time required for any observable transformation of students' habits, and along with that also the possible transformation of their taste, this transformation still takes place in the moment-to-moment interactions between students and between teacher and students. A method for studying the constitution of taste, therefore, needs to begin in these interactions in order not to overlook possibly important steps in the process. Nevertheless, as we present the methodology, we also tentatively outline how the analytical constructs could possibly relate to the more long term perspective in which the development of taste may be realized. Although these outlines are based on how taste was constituted in the science practice studied, they are not to be read as final statements on how taste develops in this specific classroom. Note that the order in which the steps are first presented to the reader is different from their order in the formal method for conducting a "taste analysis" that we eventually suggest. We do this because we judge that the logic of having the steps presented to the reader for the first time is different from how these steps are best ordered for making a formal analysis of the constitution of taste in a classroom.

Before the analysis is explained in detail, we give a brief outline of the analytical steps. First, we will demonstrate how the constitution of taste can be made visible and coded through the distinctions that the students make. To acquire taste amounts to developing habits of making distinctions of exclusion and inclusion as valued by the practice. Distinctions of taste are regularly valued by the participants in relation to norms current in the specific social practice. In the typical science classroom practice, the current taste usually originates from the teacher who distinguishes preferred ways of doing and talking science. Due to a diversity of reasons, for example home background or previous schooling, the individual student can or will acknowledge this taste to different degrees. As will be shown below, it is possible to observe and categorize how the participants in a classroom practice include and exclude utterances, actions, and persons in relation to norms that are explicitly or implicitly stated. Second, since students who do well in science do not necessarily like it, nor consider it something they can identify themselves with, it is also essential to examine how the students enjoy being part of the science classroom activities. This can be studied through how the students aesthetically judge the distinctions that they make in this practice. Third, we show how the constitution of taste can be observed also from humorous interactions in the classroom. Fourth, observations of the distinctions that students make need to be situated as part of events or activities with purposes. Being a typical educational practice, distinctions of taste in the science classroom are regularly associated with particular purposes and goals which the teacher has introduced, namely there is a scientific content to be learnt. Of importance for the constitution of taste, therefore, is the extent to which individual students, both cognitively and aesthetically, can acknowledge distinctions oriented towards these purposes. Or, in other words, to what extent do the students understand what they are set to do and how do they feel working towards these purposes. Distinctions of taste are thus associated with the learning of a particular content of science as relations of what *is* the case in terms of facts, phenomenon, and objects become, or not become, established. In the last step, we show how it is possible to observe to what degree the constituted taste (a) tallies with a taste beyond the classroom, that is, one that may be described as a taste compatible with science more generally (as recognized by other stake holders, e.g. by scientists or upper secondary school teachers), and (b) leaves room for contingent contributions arising in the moment or stemming from students' personal experiences. This final step, then, is a description of the normative restrictions that are constituted in the classroom activities.

To be able to make an analysis of the constitution of taste as part of ongoing classroom practice, we use practical epistemology analysis (PEA). PEA builds on socio-cultural theory, John Dewey's pragmatism and the later Ludwig Wittgenstein's writings (Wickman and Östman 2002). Its purpose is to "understand what people say and do during authentic classroom work and what this tells us about how and what students learn by participating in the specific interactions of a certain curricular setting" (Wickman 2004, p. 326). PEA has been adopted in numerous studies (see Kelly, McDonald and Wickman 2012). The focus is the meanings people construe in action and the consequences these meanings have for the direction learning takes. As Richard Rorty notes, it is an anti-representational account, "which does not view knowledge as a matter of getting reality right, but as a matter of acquiring habits of action for coping with reality" (Rorty 1991, p. 1). It is, thus, not a report of what people know, feel, or like with certainty, but of the knowledge and values that the participants construe in talk and action in order to proceed with the classroom activity. In this respect, the analysis may be said to look at classroom processes from a teachers' perspective.

Here we make use primarily of two of the concepts of PEA, namely *relation* and *gap* to analyze meaning-making in classroom interactions. Relations are established by the participants in an activity between the words and actions that already make sense in the situation. That words or actions "make sense" should here be understood in a strictly situational and actional sense; namely, how they in the specific moment contribute to the direction learning takes (Lave 1996) through the interlocutors' bit-by-bit negotiations (Gee and Green 1998). That words are used in this way is seen when an interlocutor is adopting certain words or actions in the specific interaction as leverage for making sense of something not yet known to participants, that is, a gap. A gap means that the persons, in action or in communication, make evident that they need to make a relation to fill the gap. It is made evident in the conversation when the interlocutors ask questions or encourage each other to find out what is the case. The circularity here is intended and necessary, because a gap may or may not be filled with a relation. When a gap is not filled with relations acceptable to those interacting, it means that the activity has to stop or that they have to start over in a completely new direction. For the purpose of analyzing the *constitution* of taste, our interest is not in just any gaps or relations, but specifically those pertaining to situations where students made explicit distinctions and judgments of taste, meaning that they included certain relations to fill the gap while excluding others, and did this in response to posing a question, disagreeing, or hesitating concerning how to handle the situation. The following short exchange between two students illustrates the concepts:

Karl: Hassan, since you got a good view there, check how high it is!
Hassan: It has gone, like, two lines up.
Karl: [laughs] You can't say it like that.
Teacher: Then you have to calculate how much two lines…
Hassan: Two millimeters.
Teacher: What is the value of each line?

Here Karl and Hassan were looking at a graduated cylinder to see how much the water surface had risen after immersing a weight. We can here see that Karl told Hassan that they needed to know something, because Karl said that they needed to check how high the water level was. This is technically coded as noticing a gap, in this specific case regarding how high the water level was. They agreed on that this gap needed to be filled as was evident from Hassan trying to fill it with a relation. The relation Hassan delivered was "It has gone, like, two lines up". This is called a relation as he suggested a relationship between the words "gone up" and "two lines" to fill the gap (about how high it was). But Karl, as can be seen from his response, questioned Hassan's relation by saying "You can't say it like that." In doing this Karl noticed another gap, which they needed to fill with additional relations. Here the teacher was seen to support the students with additional relations about how to fill these gaps, namely how to properly talk about how to measure the change in water level. This conversation continued until the students were able to make appropriate scientific distinctions about how to talk about this (see detailed analysis below). If these gaps had not been filled with such acceptable relations, these students would not have been able to continue with the task at hand together and develop the distinctions necessary for taking part in this classroom.

These gaps and relations are not studied as isolated occurrences, but as events constituted in encounters through action and communication as part of whole practices. They are of particular interest in studying the constitution of taste. This is because only gaps that are noticed in action by the students can be filled with relations. The gaps noticed by the students are thus an important part of examining how students learn to make distinctions of taste in the science classroom. But also the relations construed to fill the gaps are important to examine with regard to taste. The relations established by the students in classroom transactions can be similarities or differences (Wickman and Östman 2002). In the example above, Hassan can be said to having construed a relation of *similarity* between "it" and "gone, like, two lines up". In this way Hassan made a distinction of *inclusion*, that is, that this is a relation which may count as belonging in the science activity. Karl, on the other hand, made an *exclusion* in the last statement, indicating a relation of *difference*, namely that "it" cannot be described as "gone, like two lines up". Karl also related this exclusion to laughter and, thereby, construed a relation in terms of an aesthetic judgment. In this way students, by noticing gaps and filling them with relations, can be said to negotiate the cognitive, normative and aesthetic distinctions that belong in the science classroom. Together these processes can be used to examine the constitution of taste for science.

As we will argue below, each of these steps is needed as part of an analysis of how taste is constituted in action in the science classroom. We want to emphasize once again that our presentation should not be read as a demonstration that the students in this classroom acquired a taste for science. Instead, it should be read as an outline of five important constructs which can be used to examine how taste is constituted in the moment-to-moment interactions between the participants of the science classroom as it would be apparent to a reader. Whether individual students develop a certain taste or not cannot be answered through the short examples that we present here. But the analysis we suggest offers a way to observe instances in which taste for science is at stake in the activity and, hence, analyze in what respects the teaching affords or constrains the students to develop a taste for the science taught. Neither should the constructs be understood as separate entities. As will be seen, the constructs are indeed entwined and continuous in action. They should best be understood as analytic distinctions for the specific purpose of our methodology.

1. Observing taste as distinctions

In line with our previous theoretical discussion, the constitution of taste becomes observable through overt distinctions, which are the choices of actions and the judgments people make in dealing with themselves, other people, objects and events as part of classroom practices by construing certain gaps and relations. The choices of action are evident through:

A *Procedures* distinguished, i.e. how students choose to proceed in action as seen through the acts they include and exclude

B *Language usage* distinguished, i.e. the various representations of content and phenomena that students decide to use, as seen through the words or other signs that they include and exclude. Language usage is thus approached in a multi-representational sense (Kress, Jewitt, Ogborn and Tsatsarelis 2001) and, therefore, acknowledges the diversity of ways meaning could be construed in the science classroom (e.g. using words, numbers, diagrams, or models)

C *Ways-to-be* distinguished, that is what kind of persons that students decide belong in science class as seen through who they include and exclude

In choosing some procedures, language and ways-to-be rather than others, students are making normative judgments. However, it is not enough that they simply do or say anything; it must also be evident that they actively make a distinction. This can be demonstrated when they include some procedures, language usages and ways-to-be, while at same time excluding others. Analytically we see this as students construe certain relations instead of others in response to an explicit gap that has been noticed. This is a way of making sure that the analysis focuses on those distinctions which are actually constituted in class rather than on those merely transacted habitually because they are already part of classroom practice. Dividing the distinctions made by students into these three categories should not be seen as the only possibility, but rather as a heuristic helping the analysis not to forget important ways in which people make distinctions in action. As will be seen they are intertwined.

A. Procedures distinguished Taste involves developing certain ways to act by distinguishing certain acts as proper for a situation. Learning such procedures means noticing gaps about different possibilities to act and to inquire into alternative relations that may constitute ways to proceed in the situation. The following discussion between Erik, Ali, and Hassan illustrated one such event. In order to measure the volume of a weight the students needed to make sense of the scale on a graduated cylinder. In the following excerpt Erik, Ali and Hassan had just immersed the weight into the water of the graduated cylinder:

1. Karl: Hassan, since you got a good view there, check how high it is!
2. Hassan: It has gone, like, two lines up.
3. Karl: [laughs] You can't say it like that.
4. Teacher: Then you have to calculate how much two lines…
5. Hassan: Two millimeters.
6. Teacher: What is the value of each line?
7. Hassan: Milliliters.
8. Teacher: But no, look and compare between steps.
9. Hassan: Two milliliters.
10. Teacher: You do it in math on the number axis then we see that…
11. Hassan: Yes it is two milliliters.
12. Teacher: Between that line and that line, do we then know how much one of those small lines amounts to?
13. Karl: Ten
14. Hassan: Centimeters.
15. Teacher: Milliliters [whispers to Hassan].
16. Karl: Fifty.
17. Teacher: Milliliters [points at the graduated cylinder].
18. Hassan: Milliliters.
19. Karl: Thirty, forty, fifty, no it's not, it's…
20. Hassan: But I said that.
21. Hassan: But it's milliliters
22. Teacher: Check that it's right.
23. Karl: It's five.
24. Hassan: Exactly, it's two milliliters.
25. Teacher: Check that it's right.
26. Hassan: Yes, exactly
27. Karl: But be quiet Hassan. Five, ten, fifteen, twenty, twenty-five, thirty, thirty-five, forty, forty-five…
28. Ali: It's two milli- [to the teacher]…

29. Erik: No five, twenty-five, no five [to the teacher].
30. Hassan: It's five.
31. Karl: Five between each step.
32. Ali: Twenty-five.
33. Hassan: It's ten, yes it has risen two lines.

In turn 1 Karl wanted Hassan to read the scale in order to see the change effected by the immersion of the weight. This gap about how much the water had risen had to be filled with relations in order for the students to continue with the activity. Beginning in turn 3, however, another gap was noticed which concerned distinctions about how to proceed with reading off the scale of the graduated cylinder. In the turns which followed, these distinctions became observable as the students, together with the teacher, explicitly included certain ways of doing this while excluding others. Filling this gap thus entailed construing numerous relations that amounted to distinctions about how to proceed, for example using milliliters rather than millimeters and how many milliliters the distance between two lines corresponded to. The important thing here is not that students knew certain distinctions, but the fact that it can be shown that they were engaged in making certain distinctions for how to proceed, and hence, what counted as proper ways to act in this science lesson.

We argue that instances like this one, in which we can observe distinctions being made in action, are important to begin to understand how students may develop a taste for science. It is possible, for instance, that the way this was done in the example above, where the students and the teacher jointly negotiated how to proceed in class by making certain distinctions, may have a positive effect on these students' opportunity to develop a taste for science. Indeed, we may imagine alternative courses of action less conducive to such a development. For example, the teacher could have downgraded the students' suggestions as erroneous, or she could just have told them straight away how to read off the scale. However, as is evident from the excerpt this was not the case. Instead, different courses of action were open for discussion, offering the students the possibility to actively construe the necessary distinctions to proceed. As there is not just one way of making distinctions, it is a matter also of taste how the students and teachers decide to proceed with their undertakings. If certain procedural distinctions come to be made habitually in class, for example of how to read the scale, a taste for certain ways to proceed may be observed to have developed.

B. Language usage distinguished Taste also comprehends a preferred vocabulary, as well as other ways of using signs to communicate the content. This is perhaps most obvious through the ways in which the interlocutors include and exclude certain words, including analysis of both the gaps that the participants notice about what are the appropriate words to use and the relations where such preferences are construed. The following excerpt (turns 34–42) exemplifies this; the students had lowered the weight into the graduated cylinder and were now discussing the appropriate words to use in describing what has happened:

34. Susanne: Move away, now we've written, like this, you, we lowered the material, into, wait. Down into…
35. Amira: Why did it happen?
36. Susanne: Into the water into the can, don't know what we lowered down.
37. Amira: I wrote like this: five, we lowered the weight in water, into the wate-…, in…
38. Susanne: Into the water. Can.
39. Amira: Into the cylinder.
40. Susanne: Graduated cylinder.

41. Amira: Into the graduated cylinder.
42. Susanne: Lowered the weight into the graduated cylinder. And…

This discussion contained explicit gaps about how to name the different objects needed to describe what happened when the weight was being immersed. Certain names for the graduated cylinder and the weight were included whereas others were excluded. A difference was construed to "can" (38) and to "material" (34), and a similarity to "graduated cylinder" (40–42) and "weight" (37, 42), respectively. Another example, which is not shown here, is one in which the students discussed how to describe what causes the water to rise when the weight was immersed. In this case they settled for "because it pushes away the water" rather than "It becomes heavy, there is tension in the water". Also in the earlier excerpt, turns 1–33, the students made distinctions regarding language usage, for instance in choosing between "millimeter" and "milliliter".

As before, the example illustrates an instance which potentially afforded the development of a certain taste for science. In this example, however, the students engaged in the negotiation of distinctions without the direct intervention of the teacher. Irrespective of why, the students obviously felt free to engage in a discussion of how to name the things used and, when doing this, they distinguished some words as better than others. Also as before, we can easily imagine alternative ways of how situations like these could be approached. The most obvious would be the behavior of actually distinguishing that there are preferred ways of talking in the science classroom, another one that the students do not perceive this kind of naming as something they are able to engage in in the first place. The judgments made by the students in the example above may be explained by the fact that the teacher recurrently stressed the importance of naming things. It is likely that practices where aspects of taste are habitually distinguished in certain ways by the teacher, for example how students were taught that there may be better and poorer ways to name objects in the science classroom, will affect the students' opportunity to acquire a taste for science. The actual reason for why Susanne and Amira so carefully decided on proper words and what it meant for their long term development of taste is, however, beyond the scope of this paper. The main point here is, of course, that the constitution of taste is observable in action, as the participants engage in situated distinctions of how to talk in the science classroom.

It may be noted, finally, that in learning to make such distinctions as have been illustrated in the two examples, students were also engaged in conceptual development, although this engagement, with regard to taste, is operationally observed in the distinctions negotiated about language usage and ways to proceed.

C. Ways-to-be distinguished In order to study the constitution of taste in the science classroom, we also needed to document empirically what it meant to be distinguished as a person that belongs in science. It is well known that students talk about themselves and others as belonging to specific groups and subcultures and that certain characteristics may distinguish them as being a science student (Costa 1995), for instance being able to succeed in this difficult subject or having certain stereotypic traits of a science nerd (Schreiner 2006). In describing the constitution of taste it was thus necessary also to study the gaps and relations where ways to distinguish what kind of people should be included and excluded in science were constituted and whether the students could meet those standards or not. Below we illustrate also how this kind of distinctions can be observed in action. Only in this way can it be made evident how ways-to-be are constituted in different classes depending on their settings. The following two excerpts, where Hampus jokingly labeled himself as the brain in the group, was an example of this:

43. Hampus: I'm the brain so I'll say what you should write and you write and later I copy you.
44. Johan: You? Brain!
45. Hampus: No, but.
46. Johan: Measuring volume…

That Johan disagreed with Hampus (44) constituted an explicit gap concerning who Hampus really is. This made Hampus take back his statement of him being the brain (45). However, they seemed to acknowledge that someone could be the brain in the science classroom. A closer analysis reveales that a similarity was construed between "brain" and "say what you should write" (43). Apparently, "the brain" was the one who knew what to write. By also construing a relation of difference between "Hampus" and "brain", Hampus was excluded from being a person who makes proper distinctions in this class. Only those who were "brains" could make the right distinctions, and Hampus did not belong to that group. Later Hampus returned to this incident:

47. Johan: Okay, what shall we do?
48. Hampus: I don't know. I didn't listen.
49. Johan: Did you listen [to Mio]?
50. Hampus: I rely on you here, since I wasn't the brain.
51. Johan: What shall we do [to Mio]?
52. Hampus: What have you written?
53. Johan: What it says there [the whiteboard].
54. Hampus: Oh, it sounds…
55. Mio: Write a hypothesis!
56. Johan: I do as Mio does.

The students were not sure about what they were supposed to do and Peter therefore asked Hampus for assistance (47). Hampus, maybe a bit grumpy, referred to the fact that he was not the brain in the group and hence trusted the others for guidance (50). When Mio uttered "write a hypothesis" (55) Johan said that he would do what she did (56). Here, again, Hampus construed a relation between "brain" and being able to make the right distinctions in class; in this case about what should be done.

These excerpts thus demonstrate how distinctions may be observed regarding how ways-to-be count in this science classroom. Here, the students distinguished what kind of people should be included and excluded in science (brains should be included and brains know what to write and what to do) and whether the students could meet those standards or not (Hampus did not meet those standards). As before, we could imagine other kinds of inclusion and exclusion that have less to do with the culture of science and more to do with the identity and background of students in terms of, for example class, gender, or ethnicity. This, in turn, should be expected to be closely related to the kind of lingual and procedural distinctions students make, for instance if male or female ways of behaving are given priority (Arvola-Orlander and Wickman 2011).

2. Observing taste as aesthetic judgments

The ways students engage in making distinctions treated above is a necessary step in analyzing the kinds of taste that are constituted in science class. However, it is just one step of identifying potentially important instances that can be further analyzed and coded concerning the distinctions that students construe as part of their activities. Indeed, we could imagine students mechanically making these distinctions and, so, successfully proceed with the activity. But this alone cannot be used to describe the kind of taste for science that develops in class. Britt Lindahl (2003) made longitudinal interviews with students in compulsory school about how their interest for science developed over the years. She reported that many of the best science students did not decide to continue with science in upper secondary school, because they found science boring. Such students could not count as having developed a taste for science in their classrooms. This highlights the necessity to study in situ also how students value taking part in science class. The second step, therefore, was to study taste as aesthetic judgments and in this way include in the analysis also how students valued and enjoyed taking part in making certain distinctions in the science activities. We focused on the use of the aesthetic judgments in order to describe also the values that were constituted and developed as the participants made the kinds of distinctions described above. The reason for this choice was based on prior classroom research on the significance of aesthetic experiences in science and science education (Wickman 2006).

Operationally aesthetic judgments have been defined "as utterances or expressions that either deal with feelings or emotions related to experiences of pleasure or displeasure, or deal with qualities of things, events, or actions that cannot be defined as qualities of the objects themselves, but rather as evaluations of taste—for example, about what is beautiful or ugly" (Wickman 2006, p. 9). This definition has a long tradition that goes back to Immanuel Kant (Wickman 2012). In turns 2 and 3 we have already met the laughter of Karl in commenting on a distinction made by Hassan. But even more obvious judgments than laughter and gestures—although they may also be included—are the use of spoken language. Classroom studies have shown that aesthetic judgments are repeatedly used when teachers and students distinguish what should be included and what should be excluded in the science classroom (Wickman 2006). By studying aesthetic judgments it becomes possible to see how students value the inclusions and exclusions that are made. Positive aesthetic judgments are typically used about what should be included and negative aesthetic judgments about that which should be excluded in proceeding successfully with the activity. At the same time students are communicating their feelings for the distinctions that they make.

In one of the groups the following conversation took place when the students were discussing the gap regarding how to use the scale of the graduated cylinder:

57. Yussuf: Wait, how much is it between these [the lines on the graduated cylinder]?
58. Melissa: It is, like, ten between.
59. Yussuf: Is it?
60. Melissa: Yes!
61. Erik: Nice!
62. Yussuf: Wait, ahh, shit [starts to count the lines]!
63. Melissa: I mean, not ten between, but it ends up at ten. It is like nine between, or eight.
64. Yussuf: Err

We can see here how the students made procedural distinctions in response to an explicit gap, but also how they made evaluative aesthetic judgments in relation to how these distinctions helped them proceed. Erik made the positive aesthetic judgment "Nice" in a happy voice (61) in relation to Melissa's solution in turn 58 and assertion in turn 60 about how to proceed. However, Yussuf made the negative aesthetic judgment "shit" (62) in failing to adopt Melissa's finding when counting the lines on the graduated cylinder.

In analyzing the aesthetic judgments and their significance for the development of a taste for science, we do not mean that the number of aesthetic judgments should be counted, to see whether positive or negative judgments dominate. Rather we suggest that the aesthetic judgments must be understood as part of the activity as a whole and what they tell us about students' possibilities to partake and their feelings for the practice. In this respect it should be noted that aesthetic judgments are typically used on the one hand in moments of anticipation of the consequences of making certain distinctions, and on the other hand in moments of fulfillment and consummation, evaluating the consequences of what actually occurred (Dewey 1934/1980).

The aesthetic judgments of Erik and Yussuf in turns 61 and 62 should be understood in this flow of student activities. Erik can be said to have made an aesthetic judgment of his expectations from Melissa's finding, namely that they helped them finish their assignment. Yussuf's judgments expressed the opposite. In this way the aesthetic judgments of students can be used to describe the rhythm of anticipation and consummation in class and what they feel in relation to this rhythm. If the activity on Yussuf's part had stopped at turn 64, he had been left without a capacity to make the appropriate distinctions according to his own expectations as is evident from his aesthetic judgment in turn 62.

Another case of this tension between anticipation and consummation is where Peter was filling water into the graduate cylinder, and used the aesthetic judgment "perfect" to sum up what Melissa had achieved:

65. Peter: Yes, you should start by filling [inaudible].
66. Melissa: Shall I pour into that one [Melissa holding a beaker with water, "that one" = the graduated cylinder]?
67. Peter: Just to hundred!
68. Melissa: Yes I know.
69. Susanne and Peter: Stop!
70. Peter: Perfect!

Here Peter was using the aesthetic judgment "perfect" (70) as a consummative evaluation of the distinctions made of what constitutes "hundred" (67). At the same time he was also evaluating positively his anticipation and his feelings for the consequences of this moment of consummation for succeeding with the classroom tasks. Their body language (attentively fixating the scale) and their engaged voices demonstrated their emotional involvement in the task. Thus, including aesthetic judgments in the analysis in this way makes it possible to observe whether students, like Peter in the example, are emotionally engaged or not in making the distinctions necessary to proceed in this science class.

In a more long term perspective aesthetic judgments are an integral part of the development of taste. It is likely that the taste constituted in a practice where the participants recurrently use negative aesthetic judgments (e.g. disgusting, boring, bad and so forth) or where aesthetics are totally absent, would differ from practices where this is not the case. Moreover, we can also imagine that some students would benefit from getting value judgments clarified by the teacher or a classmate. Since it is not obvious why a certain distinction is aesthetically judged in a specific way, for example as being perfect or nice, this could be a matter of explicit instruction.

Not just acts may be judged aesthetically, but also the persons performing them. In the following example students again discussed the scale of the graduated cylinder and how to use it to measure the volume of the submerged objects:

71. Hampus: How much is one of those lines then?
72. Mio: One milliliter.
73. Johan: It increased ten milliliters.
74. Mio: Was that right [to the teacher]?
75. Teacher: Well, that is what you, that's what you should figure out.
76. Johan: What?
77. Teacher: What's the value of each line?
78. Johan: Five milliliters.
79. Mio: Two.
80. Teacher: He says five and you say two, now you have to discuss with each other about which one's right and why
81. Johan: Okay, because it is like this. Because it starts like this, fifty…
82. Teacher: Mm
83. Johan: Fifty-five
84. Teacher: Mm
85. Johan: Sixty, sixty-five, seventy, seventy-five, eighty, eighty-five, ninety, ninety-five, one hundred
86. Teacher: Do you buy that?
87. Mio: Yes [laughter]
88. Johan: Who is the great?
89. Teacher: He proved it to you, didn't he [laughter]?
90. Mio: Yes, but I only guessed

In this group Johan and Mio did not agree on the value of the lines (71–73). The value of each line was a gap that still lingered when the teacher approached the group (74). As with Karl and Hassan in our first excerpt, the teacher wanted the students to fill the gap by themselves and did not answer Mio's question in turn 74. Instead she encouraged the students to find it out for themselves. For Johan the value of the lines made sense (turn 78) and he helped Mio so that she was able to make the right distinctions and fill the gap. The procedure to arrive at the value of the lines was highly valued in this assignment, as may also be seen from previous excerpts. The teacher explicitly acknowledged that there was a right way to do this (turn 80) which she also clarified by asking Mio "do you buy that?" (turn 86). Also the students agreed with the notion that there is a value in distinguishing the right actions. Johan used the aesthetic judgment "the great" about himself (turn 88). The consummation of the situation was also acknowledged by Mio's and the teacher's friendly laughter (87 and 89).

The negative and positive aesthetic judgments we here present are from short excerpts, to illustrate how they can be identified as part of situations in which distinctions of taste are made. It should be noted that negative aesthetic judgments do not by themselves indicate that students fail to engage in an activity. Negative aesthetic judgments are often used by people to distinguish the *expectations* related to certain things and ways to act. If such negative things and actions can be avoided, the negative consequences may not result, but rather a fulfillment expressed in positive aesthetic terms. Hence, negative aesthetic judgments are often used about what should be avoided so as to result in fulfillment (Wickman 2006). In the following excerpt Hampus made a negative aesthetic distinction regarding the effect of the weight on the water line (turn 94). The students were immersing their first weight into the graduated cylinder and were expecting the water line to rise:

91. Hampus: Be careful! [the weight is clattering in the glass cylinder]

92. Mio: [giggles] nice thud
93. Mio: All right, is it rising?
94. Hampus: It does not rise a damn shit
95. Peter: [giggles] can I see?
96. Hampus: Yes, it rose
97. Peter: What, it didn't stand still at all, check this out

Such a negative judgment thus may express proficiency in making distinctions according to a norm. It is therefore important not to see aesthetic judgments as absolute, but as part of the situated rhythm of anticipation and consummation in class and how students' feelings towards certain objects, events, actions of people as part of science are constituted in the long term in this process. Of special consideration here is humor, which often deals with irony and that which is not the case.

3. Observing taste as humor

Although humor is a vaguely defined concept it is an important constituent of taste (Kuipers 2006). It can be defined as "a comic, absurd, or incongruous quality causing amusement" (dictionary.com 2013-09-26). It can be seen as a sophisticated and more indirect way to make distinctions in relation to a certain practice. Here we focus on what in vernacular parlance can be referred to as jokes and joking, as it was the prevalent form of humor in this classroom. Joking entails saying something containing elements that should not be taken literally or seriously, but rather should be understood as serving the purpose of amusement. However, joking, as we will see, rarely is self-contained, but part of seriously distinguishing how to proceed with activities, how to use language and about who belongs in the science classroom. By its connection with amusement and laughter it also has aesthetic continuity. Joking thus can be said to be a way of trying to make amusing aesthetic judgments and certain critical distinctions continuous, which may (or may not be) more or less successful with consequences for the constitution of taste.

In the following conversation joking was dealing with norms of distinguishing ways to proceed and word usage. The student Peter was spinning a weight on the table, which was not part of the ascribed task, when the teacher approached him:

98. Teacher: What are you examining Peter [Peter spins the weight on the table]?
99. Peter: How many laps it can spin without…
100. Teacher: Before it faints [giggles]?
101. Peter: Before the energy ends.
102. Teacher: Before the energy ends?
103. Peter: Yes, it has to sound scientific.
104. Teacher: The energy part already?
105. Peter: Yes!

In turn 100, the teacher used a joke to distinguish Peter's inappropriate ways to proceed. She was using the word "faint" in connection with a spinning weight and giggled. The joke established a relation that did not belong in science class, namely that a weight can faint. Peter responded by instead construing a relation to "energy" (101) and so showed that he did distinguish what language and procedures belonged in science class. Likewise, Peter explicitly related to current norms by also distinguishing what word usage was appropriate in the classroom: "it has to sound scientific" (103). Apparently, according to the teacher's feedback in turn 104, this was a more legitimate scientific relation to spinning a weight. In this excerpt the teacher and Peter mutually and in a supportive humorous way acknowledged various distinctions about what *words and procedures belong* in science class, and so constituted what counted as a taste for science in this situation.

This episode did not contain any explicit distinctions of norms about *ways-to-be* and what kind of person belongs in the science classroom, although it was dealing with it implicitly by distinguishing procedures and words which were related to how you may be distinguished in science class. However, there were situations where joking occurred about ways-to-be as a student. One example is the previously reported conversation between Hampus and Johan about who was the brain in turns 43–46. Hampus made a joke in saying "I'm the brain so I'll say what you should write and you write and later I copy you" (43) whereupon Johan answered "You? Brain!" (44) and Hampus replied "No, but" (46). Here we could see that Hampus's joke was not well received. Through his joke Hampus was exposing himself to the question whether the others actually were considering him as the brain who could tell them what to write. Johan took him literally and denied Hampus the status as being the brain. Thus Hampus's joke was not received as such, that is, as being humorous and an occasion for amusement. The joke did encompass relations about ways-to-be according to the taste of the classroom. In this classroom and between these two students, these were the only examples where jokes about ways-to-be resulted in an exclusion of a student. But we can easily imagine situations where the students do not understand jokes either through their consequences for procedures, word usage or ways-to-be or find them amusing and so a positive aesthetic experience. In studying the taste that is constituted in the classroom and its consequences for student continuing participation it, therefore, seems necessary to describe both positive and negative instances of humor in these respects, because they are likely to have opposite consequences for the kind of taste for science that is constituted in the classroom. For example, Cathrine Hasse (2002) has shown how the use of in-jokes between students being "inside" a specific and prestigious scientific subculture had an excluding effect on the other participants in the same physics course. In the extreme case, making jokes touches other possible genres of humor like sarcasms, where those who belong make jokes about those who do not according to certain distinctions of taste. This may go either way, those with ways-to-be that belong in science excluding those that do not, or those who do not belong in science making jokes about those that belong.

4. Situating and observing the direction of taste

We have now presented three steps for analyzing how taste is constituted in action in a science classroom. These steps aid in identifying and coding the distinctions that are made with regard to what they include or exclude, and also how these distinctions are valued through the aesthetic judgments and humor observed. However, taste in relation to education cannot be analyzed only from contingent distinctions and momentary pleasure. The observations made through the first three steps need to be situated in relation to the purposes of the classroom activities. In other words, does the taste that is momentarily constituted in the classroom lead students towards the purposes and aims of the lesson?

In analyzing the direction of such progression two components need to be analyzed. First, the purposes of the specific lesson as given to the students need to be identified. These so called *proximate purposes* constitute information provided by the teacher which the students have to act upon in order to reach a certain goal (Johansson and Wickman 2011). For example, if the over-arching goal for a unit is *attainment of an understanding of ecological principles,* likely proximate purposes could be: what animals can be found in a typical lake, where in the water are the plants and algae, what is the pH and so on. Second, we need to analyze whether the consequences of the distinctions that are made by the students are such that they go on with the proximate purposes of the lesson; that is, that the proximate purposes function as ends-in-view to the students (ibid.). Only if this is the case can it be said that students develop a taste for science specifically and not just any taste. In this fourth step, we thus examine whether the distinctions that are made under headings 1–3 are in line with the purposes of the science lesson or not. In doing this, it is often necessary to analyze a longer sequence to see how the distinctions become continuous with the purposes of the lesson.

In the lesson that was studied an explicit proximate purpose was to *measure the volume of differently shaped objects*. The talk and actions of Erik, Hassan and Ali when they had immersed the weight into the graduated cylinder (turns 1–33) exemplify distinctions of taste dealing with this purpose. As described earlier, for the boys to be able to determine the volume of the weight, several gaps were filled with relations, for example: what was the unit of the scale and how many milliliters did one line correspond to. In this case, the gaps that were noticed and the distinctions that were made, for example including milliliter and excluding millimeter, were in line, and thus continuous, with the proximate purpose of *measuring the volume of differently shaped objects*.

In her introduction, the teacher informed the students that an important aspect of doing inquiry was to properly name the things examined. Only by giving the different objects suitable names it was possible to communicate, both in text and talk, the result of the measurements. She repeatedly told the students that a name should capture some scientifically relevant quality of the object. For example, the weights might be categorized as the *small* and the *big* weight. Another proximate purpose during this assignment was thus *naming the objects*. In the following excerpt the students had just started with the assignment and were now talking about how they should proceed:

106. Yussuf: We start with these [the weights], they are the simplest [to measure].
107. Melissa: Okay, but we write down all the objects, right?
108. Yussuf: Object, what is this [the weight he is holding]? Fifty iron. It is, it says fifty on it.
109. Erik: Fifty grams
110. Melissa: Fifty grams
111. Yussuf: Fifty…
112. Melissa: No, how do you say, fifty….
113. Erik: Milligrams
114. Yussuf: Milliliters, no it can't be
115. Melissa: No
116. Yussuf: Its weight is fifty grams
117. Melissa: Okay, fifty grams, yes
118. Yussuf: Fifty grams of iron

In turn 118 Yussuf said *fifty grams of iron* which was the name they hereafter used when they referred to this weight. Before they settled for this name, though, they filled gaps by including certain relations while excluding others. As with the previous excerpt, these distinctions about what should be excluded and included aligned with the proximate purpose of giving scientifically relevant names. That is, fifty grams of iron was judged being better or more appropriate than, for example, fifty milligrams and they could proceed with the activity. Giving the metal weight a name was thus a directional and normative process, which comes to an end when the gap was filled according to the purpose.

In this example the norms concerning making the right distinctions were both implicit and explicit. That is, the students acknowledged and worked their way towards an end-in-view and in this process some things were not questioned, for example that they should name the object at all, and some were questioned, for instance "no it can't be". Hence, by analyzing to what degree the students are making distinctions that orient them towards the purposes of the lesson, it is possible to determine the direction that the constitution of taste for science is taking in relation to classroom science norm. It is likely that in activities where the proximate purposes seldom or never function as ends-in-views, a taste for science will have few opportunities to develop among the students.

5. Reproducing and contingent aspects of taste

So far we have made evident how it is possible to observe how distinctions of taste relate and contribute to a current classroom taste for science. That is, we are now able to analyze how the participants include some ways-to-talk, ways-to-proceed, and ways-to-be while excluding others, how these distinctions are valued, and how this aligns with the specific purposes of the activity. However, from a wider stakeholder perspective, the taste developed may be judged as more or less conducive to a taste that is compatible with the use of science outside the classroom. This could regard distinctions of taste in relation to for example science as practiced by scientists or to socio-scientific issues. Some things that occur in the classroom may have unfortunate consequences for developing a taste that will be helpful also to such wider fields of use. Theoretically it would be possible to teach students a synthetic taste for science, which they joyfully can take part in, but which is of little assistance to deal with science in practices outside the classroom. It is likely that a taste for science may have some normative components that are more or less recurrent in science practices in general. For example, calling a beaker a beaker instead of calling it a glass is likely to be distinguished as a better way-to-talk in most scientific settings. Another example may be how experimental skills are valued; most certainly there are better and poorer ways to set up and interpret an experiment. It has been demonstrated that practical work can be perceived, both by teachers and students, as pleasant and sometimes spectacular distractions, but with little meaning for the understanding of the content or the scientific practice (Abrahams 2009). A science practice characterized by experiments not being continuous with the aims and goals of the practice, may thus construe a taste for science with little relevance or meaning outside this classroom. At the same time, situations are always unique and therefore there is no single unequivocal taste that either needs or can be acquired in a robot fashion. For this reason, it is important to analyze also to what degree distinctions of taste from individual students are given room in the process of construing the norms of science.

Hence, the aim of this last analytical step is to examine (a) to what extent the taste that is constituted in a particular classroom reproduces what is considered as taste for science outside the classroom and (b) how students are allowed to contribute with gaps and relations contingent on their differing individual experiences of the current taste concerning distinctions of better or worse ways to proceed, talk and be. Together, the reproducing and contingent aspects allow an analysis of how the classroom norms are related to the science curriculum as construed beyond the classroom, both to science and to other fields of importance to the students' lives. Both these aspects may be significant for developing students' taste for science.

In the classroom practice here used as an example, an important part of measuring the volume was to understand the scale of the graduated cylinder. During the assignment the teacher explicitly distinguished that an understanding of the scale was a necessity when measuring things. She also repeatedly stressed that there was a favored way to arrive at this understanding, namely by counting the lines the same way you do in math class. Therefore, being someone that can read off a scale and also understand the underlying logic of it was likely to be important aspects of the scientific taste in this classroom. From the scientist's perspective, this should be a distinction compatible with a scientific taste, because having an understanding of the scale is important in most scientific practices. As described earlier, the teacher and the students distinguished this normatively through ways-to-talk, ways-to-proceed, and ways-to-be. However, due to experiences of individual students, the process of reaching an understanding of the scale followed different routes as contingent gaps were noticed and filled.

In the following excerpt the teacher included a contingent joke from a student. In this example two different ways of naming things became visible, one in line with the scientific practice and one more general, and, apparently: funny. One of the students in the group told the teacher that they named the weight "small weight". The teacher responded by saying "but that is really good" (turn 121). "Small weight" was thus valued as an appropriate name and the student could continue in the direction suggested by her.

119. Teacher: Those yes, precisely. One at a time. And then you name it something. This is a…
120. Kim: We wrote small weight
121. Teacher: But that is really good
122. Anna: Can you name it Jonny?
123. Teacher: It is a small weight
124. Anna: Can you name it Jonny?
125. Teacher: You can name it Jonny as long as you tell that Jonny is the small weight
126. Anna: All right
127. Anna: But we have not done that
128. Teacher: It works nicely, Jonny small weight
129. Anna: Immerse Jonny small weight
130. [laughter]

In turn 122 Anna humorously asked the teacher if it is possible to name the weight "Jonny". The teacher did not brush this away but rather used the student's suggestion to clarify the logic behind the scientific way of naming objects (turn 125): the actual name was not important as long as it captured the quality of the object (Jonny is the small weight). In turn 128 the teacher again acknowledged this by uttering an aesthetic distinction, "It works nicely, Jonny small weight". The student found this funny and laughed when she jokingly included the, not so scientific, name with the scientific practice of the hands on activity: "Insert Jonny small weight" (turn 129). The teacher's response to "Jonny" is an example of what it may look like when distinctions of a more everyday taste are negotiated and made continuous with the taste current in the science classroom. Instances like these, where distinctions of taste are playfully negotiated, are likely to be of importance for students' opportunity to develop a taste for science.

Summing up the methodology

As we noted before, the detailed outline of the different analytic steps that we have provided was done according to a logic which we believe is best suited when these steps are first introduced to the reader. As we hope that, by now, the reader has appreciated both the theoretical and empirical basis for each step, we now present another logic of the steps, one which we believe best suites the purpose of conducting a "taste analysis" of the moment-to-moment interactions in the science classroom. The summary below demonstrates step-by-step how the complete methodology could be used when analyzing the constitution of taste in a specific activity.

1. Examine what the purposes of the activity are The aim of the first step is to clarify the aims and purposes of the activity: What are students supposed to do and talk about? The proximate purposes are evident as the science related tasks the students are set to do by the teacher, for example *giving the objects suitable names* or *measuring different shaped objects*. Thus, in this step we ask:

- What are the proximate purposes of the activity?
- How are these purposes made clear to the students?

2. Examine whether the distinctions of taste orient the students towards the purposes of the activity In this step, distinctions of taste are analyzed as the choices of action evident through how students choose to include and exclude certain (a) procedures, (b) words or concepts, and (c) ways-to-be. Analytically, the constitution of taste is evident when the students chose a certain course of action and at the same time exclude another one in order to reach the proximate purposes. In classroom activities that have a positive effect on the constitution of taste for science, the proximate purposes need also be ends-in-view for the students. In principle this means that the students include procedures, words and each other in ways that are conducive to purpose. Thus, in this step we ask:

- Are the distinctions (language, procedures, and ways-to-be) made in line with or opposed to the purposes of the activity and so with the current classroom taste?

Together the first and second step can be used to see what kind of purposes and classroom interactions that are conducive to developing the normative and cognitive aspects of the current classroom taste. Clearly, teaching is central for the students to learn how to distinguish actions oriented to purposes and so developing habits of making distinctions of taste in the science classroom. Of importance is, for example, the proximate purposes introduced and how these, as a result of the doings of the teacher, become ends-in-view for the students. The proximate purposes not only need to be understood and so possible to act upon, but the students also need guidance in distinguishing preferred actions towards these. Therefore, the extent to which the participants are given opportunities to develop a taste is implicitly evident when these steps are analyzed. It is to be expected that practices where the proximate purposes never become ends-in-view will have a negative effect on the constitution of taste for science.

An important part of learning which distinctions are preferred in the science practice is to learn how these are aesthetically valued, and the next step in the analysis is to examine this, namely how students value and judge the distinctions of taste made in the classroom.

3. Examine how the distinctions made are valued through aesthetic judgments and humor In this step it is analyzed on the one hand how students aesthetically judge the inclusions and exclusions of ways-to-act, ways-to-talk, and ways-to-be, and, on the other hand, how they value the distinctions in terms of humor. Thus, in this step we ask:

- How are the distinctions that are made being valued by the students through aesthetic judgments and through humor?

In principle, this part of the analysis can be described as an examination of how students enjoy and value various distinctions and, so, enjoy being part of the practice. Also aesthetic judgments can be transacted habitually. It is not self-evident why, for example, it is *better* to say "graduated cylinder" than "can", or why an experimental set up is described as *neat*. It is, thus, likely that settings where specific aesthetics of the practice are overtly discussed and negotiated may affect the development of taste for science positively. Again, the teacher has a central role for how this is to be realized.

However, although the taste constituted in the classroom may be in line with classroom purposes and also be enjoyed by the students, it will be of little further use if it is functional and valued in this specific practice only. It is, therefore, necessary to analyze to what extent the distinctions of taste are also continuous with the taste in other fields of use. The aim of the fourth and fifth steps in the analysis is to clarify this.

4. Examine how distinctions relate and contribute to the norms beyond classroom practice This part of the analysis aims at examining to what degree distinctions of taste support the development of a scientific taste that is functional in other fields of use than the classroom. In this step we ask:

- How do the distinctions relate and contribute to a taste for science that is current beyond the classroom?

In our data, acknowledging the understanding and usage of a scale exemplifies distinctions of taste that can be said to be compatible with a scientific taste as practiced by a scientist. It is likely that this norm will be acknowledged not only if the students enter upper secondary school or an eventual tertiary science educational program, but also in various every-day situations where an understanding of measurement is required. This step is crucial to establish whether the taste developed has a place in society generally. It is possible that classroom practices where science always is distinguished as "spectacular experiments" or, maybe, the opposite; "science is the transmission of known facts" may advance a taste for science with no persistent meaning outside these settings.

At the same time, the constitution of taste cannot be a universal process having the same crucial components in every classroom and to every student. On the contrary, the development of taste is a social process open for the contingent contributions of the individuals in the specific classroom setting. The aim of the fifth and last step in the analysis is to examine how the distinctions of taste support the development of a taste that is functional in fields concerning the students' everyday lives.

5. *Examine how distinctions that include students' various idiosyncratic experiences are allowed*. In this step we therefore ask

- How are students allowed to make their personal contributions to the taste developing in the classroom?

Hence, when analyzing the reproduction of a taste in the science classroom that is current beyond its walls (step 4), individual distinctions necessary for construing these norms should be analyzed too (step 5). We can imagine a diversity of instances where a development of taste is both supported and opposed as a result of how the more everyday distinctions of the student are acknowledged. For example, practices recurrently downgrading individual distinctions will most likely have a negative effect on the development of taste for science.

Together the five steps and six questions make it possible to analyze what kind of taste that is constituted in the classroom and how the various components described in each step interact in its development.

Discussion

In this paper we have developed a methodology for examining how taste for science is constituted in the moment-to-moment interactions of the science classroom. This is done by identifying instances in which the participants of the classroom respond to explicit gaps by making distinctions about ways to talk, act, and be, and analyzing how these distinctions align with the purposes of the classroom, how they are judged aesthetically (including humor), and how they align with other norms outside the classroom, both those of science and those relating to the students' lives more generally. The purpose of the method is thus to enable empirically grounded accounts of *how,* and *what kind* of, taste for a subject is constituted in situated practices and how the various encounters that occur in those practices may contribute to the development of such a taste. As argued in the paper, our primary interest is the understanding which the methodology may generate in terms of what a teacher can do to help students acknowledge, learn, and appreciate the taste distinguished in the science classroom. The uniqueness of every individual classroom, for example in regard to student group background or teaching style, suggests that there is a variety of ways in which enjoyment and competence could develop towards what is usually recognized as an interest in science. Consequently, there should be a variety of ways through which this process could be supported by a teacher. However, although the data that we have used to develop the methodology give some examples of how such teacher-student transactions may influence the taste that is constituted, empirical research specifically addressing this process is needed, before any claims can be made. Again, the analysis of data made here has the single purpose of developing and illustrating the methodology as such.

The method that we suggest could make an important contribution to the field of students' interest in science precisely because it offers a way of connecting the results from more psychologically oriented studies with analyses of the situated constitution of taste in real classroom interactions. Clearly, having an interest in science is not only a matter of feelings or motivation. Indeed, one could argue that there are at least three different ways in which interest may reveal itself in a young person's actions, namely (a) how they take part in science class, (b) how they may consider science as a future career choice, and (c) how they include science as a relevant part of their daily lives. Here we have used the methodology to investigate mainly (a) although it may touch upon also (b) through the choice of a school where an unusually high proportion of students apply for the Natural Science Program. However, if we want to begin to study the detailed mechanisms which are at work when students develop an interest for science in any or several of these respects as a result of what happens in school, this can be done by the methodology that is outlined here. Naturally, before any final judgments can be made on the benefits of this approach, the methodology need to be supported with more evidence from other content areas, grade levels, and classroom settings. In a preliminary study, therefore, other science practices have been analyzed using the methodology presented (Anderhag, Hamza and Wickman in review).

Certain more general aspects of classroom contexts have been reported to have a potential impact on student attitudes toward science (Tytler et al. 2008). We know for example that students with positive experiences of science often refer to an engaging or passionate teacher (e.g. Boe, Henriksen, Lyons and Schreiner 2011). Other factors suggested to have a positive effect are for example laboratory work (Hofstein and Lunetta 2004) and activities emphasizing socio-scientific issues (Tomas and Ritchie 2012). At the same time, it is well known that while students value labs in some general sense, in specific classes that may not be the case (Säljö and Bergqvist 1997). This is not surprising considering that learning, and therefore also the development of taste, is a situated and contingent process. By examining how science is distinguished, valued and made continuous in classrooms characterized by different ways of teaching such as the ones mentioned above, it should be possible to empirically explore the consequences different kinds interactions, with for instance laboratory materials, with socio-scientific issues or with teachers, have for the taste constituted in the classroom.

The active role of the teacher with respect to how proximate purposes are chosen, valued, and made continuous may be an important focus for such a study. For example, what purposes are stated in a setting where students perform laboratory work, what skills are acknowledged and made continuous and how are these judged through aesthetics and humor, and do students distinguish themselves as members of a certain practice? Another question may be how a more generally applicable taste develops through the taste of the more proximate classroom purposes and in interaction with students' more personal taste. Such a study would be a complex enterprise, but at the same time a way to establish what progressions for learning a taste for science may look like under various circumstances.

Although there may be similarities regarding how science is distinguished in different classroom settings, it is likely that the taste constituted will also show significant differences between the settings. We therefore believe that the aim of further studies should not be so much to determine if there is a one and only preferable or more successful taste for science, but rather to describe empirically how taste is constituted in different practices. Nevertheless, there is probably also a possibility to make more general conclusions about how students become socialized into science practices. For example: What science is consolidated and developed at different levels in the educational system? How do the teachers and their students distinguish this science? How may the teacher support progressions of students? How important are students' contingent and personal distinctions of taste for the development of habitual distinctions of taste? Studies examining questions like these have the potential to increase our understanding of why some settings are more successful than others in developing a certain kind of taste for science.

It is well-known that students turn away from science at an age corresponding to the transition from lower to upper secondary school and that this decline to some extent corresponds to experiences from science class (Lyons 2006). Although there is a diversity of explanations for this decline, it is likely that, at least partly, this can be associated with how science is normatively construed at different levels in the school system. There is also evidence that different sub-groups of students value and appreciate different aspects of their school science (Tytler et al. 2008), and that, as described in the beginning of this paper, students from some social groupings have difficulties to relate to science whatsoever. At the same time there are interventions that show how also students with little taste for science may find rewarding qualities in the school subject (Calabrese Barton 2003). In addition to the possibility to study the taste that is distinguished at different educational levels, it should also be rewarding to study taste for science in different socio-economic and cultural settings. A possible outcome from a more comprehensive investigation could thus be a greater understanding for how teachers and students construe a taste for science which fits with different identities (cf. Brickhouse et al. 2000).

Moreover, the highly situated activity of making and responding to jokes and what it means for valuing science is poorly understood (Hasse 2002). As shown in this study, humor can be used to distinguish taste in a, seemingly, constructive way. That is, through humor the teacher and the students acknowledge ways-to-talk, ways-to-proceed, and ways-to-be. At the same time humor can be used for exclusion. It is likely that humor, as well as the other signs of taste that we discuss in this paper, are important features in school generally. We therefore expect that the study of taste could be useful in other school subjects as well.

Although the backdrop for the methodology was partly motivated by the reported decrease in interest for science, our intent is not that every student should choose a science educational career. Rather we argue that there is not a single taste for science. Each and every socially and personally situated taste needs to be acknowledged by educational researchers, so that we can better understand and support the various roles that science may have in young people's lives.

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