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Spontaneous Play and Imagination in Everyday Science Classroom Practice

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Abstract In science education, students sometimes create and engage in spontaneous science-oriented play where ideas about science and scientists are put to use. However, in previous research, little attention has been given to the role of informal spontaneous play in school science classrooms. We argue that, in order to enhance our understanding of learning processes in school science practices, research that investigates play as an aspect of everyday culture is needed. The aim of this paper is to explore students' informal play as part of activity in lower secondary school science. The empirical study was conducted in two Swedish compulsory schools in grade 6. Data were collected throughout a teaching unit called 'The Chemistry of Food' during a 10-week period using video and audiotape recordings of classroom work. Our analyses show that the play students engage in involves the transformations of given tasks. We find that students' spontaneous collective play offers opportunities for them to explore the epistemic values and norms of science and different ways of positioning in relation to science. Our findings contribute to the understanding of how learning in the school science classroom is socially and culturally–historically embedded and how individual students' engagement through play may transform and transcend existing classroom practices.

Keywords Spontaneous play · Imagination · Science learning · Lower secondary school · Classroom practice · Vygotsky

Introduction

In our studies of inquiry-based science education (IBSE) in Swedish classrooms, we have repeatedly come across students engaging in playful activity during science lessons. Sometimes the spontaneous play appeared to have little to do with the agenda of the science classroom, whereas sometimes it appeared to be more or less related to ideas about science

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and scientists. For a science teacher, who is conscious of following a predetermined curriculum, student-initiated play may be thought of as a distraction from the serious business of the science curriculum. An institutional perspective may be that the students are ‘off-task’ (cf. Maybin 2007). In previous research, different kinds of unsanctioned activity have been characterised as being unrelated/parallel to (Gilmore 1983) or in opposition to (Gutierrez et al. 1995) official classroom activity. A more fluid and dynamic perspective on classroom work suggests that unofficial activities in general may not only orient towards and include links to the official formal agenda, but also that official activities are infused with informal practices and procedures (Maybin 2007). In this article, we draw on ethnographic classroom research to argue that a division between students being ‘on-task’ and students ‘playing around’ is perhaps not as clear-cut as is sometimes assumed. We follow a line of thought from Lev S. Vygotsky and conceptualise students’ play as creative transformation of their experiences, as a way of creating a world that meets their needs and interests. From this perspective, students’ spontaneous play may allow them to interpret their experiences, dramatise, give life to and transform what they know into a lived narrative (Vygotsky 2004). Our aim is to explore students’ spontaneous informal play as part of activity in lower secondary school science in order to contribute to our understanding of the processes of learning science in school science practices. We do this by investigating students’ self-initiated spontaneous play as a part of everyday culture in science education, how it emerges and in what ways it opens up for students to explore ways of positioning themselves in relation to science and science education.

Play as a Life Span Activity

Play has long been recognised as an important aspect of particularly young children’s learning, and there is extensive literature on play in general related to early childhood education (Lindqvist 1996; Moyles 2005; Singer et al. 2006). When it comes to science learning or science education, however, research on play is scarce and rather scattered. In this section, we give an account of previous research initiatives on play and science education and argue for the value of a life span approach to play. In our review of previous research, which is based on database searches of the *ISI Web of Knowledge* and *Google Scholar*, we discern different orientations in analyses of play and science learning in terms of the formality in different conceptualisations of play (play as formal, semi-formal and informal). In the following, we account for previous research about play and science learning at different levels of the educational system.

Play and Science Learning in Preschool

In preschool, play—in particular ‘free play’—has been recognised as an important part of learning in general ever since Friedrich Fröbel’s work in the early 1800s (Lindqvist 1996). Across the world, opportunities for play have been recognised as essential features in developing an early childhood education of high quality (Pramling-Samuelsson and Fleer 2008).

In relation to science learning in preschool, however, there are fewer studies of play. Henniger (1987) analyses what attitudes to learning science are developed through play. His findings indicate that willingness to engage in divergent thinking and motivation to learn science and mathematics may be developed when preschool children are given opportunities to explore and create in low-risk situations. Fleer (2009) examined relations between everyday concepts and scientific concepts in children's playful encounters in preschool centres. She found that, when teacher programmes were oriented towards concepts rather than materials, children's play was focused on conceptual connections. In the study, Fleer mapped multiple and dynamic levels of thinking that children exhibited within play-based contexts. Her results indicate that playful learning contexts may generate scientific learning in preschool children and that playful events can provide conceptual spaces for the interlacing of everyday concepts and scientific concepts. Goldhaber (1994), who analysed one typical story of 'real-world' teaching in kindergarten, shows that the early childhood teachers focused on not having enough time or resources and that play was not considered as a primary medium for learning. In the analysed story, a preschool teacher expressed insecurity in relation to whether children may be allowed to play if the activity is to be called science.

Play and Science Learning in Compulsory School

In relation to compulsory school science education, there has been some research concerning play as part of formal instruction in terms of making use of role play and computer games. Persson's (2010) longitudinal study concerns how third grade students' reasoning about earth system science develops through playful instruction. McSharry and Jones (2000) argue that role play in science lessons is underrated and underused and attempt to provide a theoretical basis for the use of role play as part of developing the experiential side of teaching science. Aubusson et al. (1997) claim simulation–role play to allow students to demonstrate their understanding, explore their views and develop a deeper understanding of phenomena, although they do raise concerns about students' capacity to distinguish role play from the subject matter being studied. Burton (1997) provides detailed steps to guide teachers through the process of role play in order to enhance learning in science. During the last decade, with the growth of educational computer games and programmes, emphasis has also been placed on play with computer programmes, or gameplay, as an instructional method (Barab et al. 2007; Ioannidou et al. 2010; Nilsson 2010; Roussou 2004; Steinkuehler and Chmiel 2006).

In addition to the studies of play in formal settings and gaming, there is one study by Segal and Cosgrove (1994) inquiring into informal play and science learning. Segal and Crosgrove were working with a study on a topic other than play when they stumbled on the phenomena of play in an interview with two 6-year-old girls. In this interview, the two girls began to play. Segal and Crosgrove note that the girls made use of their learning experiences from a recently completed unit on light and suggest that play may bridge 'natural learning' and science education in primary school. Although this study does not take place in regular classroom practice, the authors point to the possibilities of incorporating opportunities for play in primary school science education.

Play and Science Learning at the University

In relation to learning science at the university, there are several studies of computer games as methods of instruction (Craighead 2008; Johnson and Mayer 2010). In addition, one study by Hasse (2002) takes an anthropological approach to play during physics learning and discusses how play contributes to students' preparation for a physics career. Hasse describes how play allows predominantly male students to try out positions as scientists and use their imaginations. She showed, for example, that participating in games, where students create new experiments rather than adhering to given tasks, prepare the students for lives as scientists.

Play and Science Learning Over a Life Span

In sum, we find that the approaches to study play in different parts of the educational system (e.g. preschool, compulsory school and university) are slightly different in terms of formality. Hasse's (2002) study of play in physics is unique in its focus on informal play as an integral part of learning science in a formal setting. Studies of school science have focused on play as a method for formal instruction. And research on play in preschool science learning has taken a semi-formal approach, recognising informal play as mediating formal learning (although critique against combining adult pedagogical intentions with children's free play has been raised in early childhood education research on play generally; cf. Halvars-Franzén 2010). In spite of the different orientations of previous research on play and science learning, there is little reason to expect that informal play would be of less importance as an integral part of learning science in school as compared to learning science at the university (though there are important differences relating to the goals and motives of educational activity in different forms of schooling; cf. Andrée 2012).

Here, we embrace a cultural approach to play as life span activity, i.e. we do not restrain informal spontaneous play to adult-initiated pedagogical play nor to the domain of (younger) children. This approach may be contrasted with a dominant approach to play as inspired by Piaget's developmental theory, emphasising developmental stages and implying that play gradually becomes replaced by more mature, adult-like activities (Baumer and Radsliff 2009). Hasse's (2002) study of play as an aspect of physics learning at the university and other studies of adult play (Talamo et al. 2009) and multigenerational play (Ferholt and Lecusay 2009) lend support to conceptualising play as a life span activity. In order to enhance our understanding of processes in science education practices in schools, research that investigates play as an aspect of everyday culture is needed.

Play as Imagination in Action

There is a large body of literature that has attempted to define the qualities of play from diverse and theoretical starting points (cf. Fleer 2008; Wood 2009). Here, we take an anthropological approach to students' play using Vygotsky's notion of play as imagination in action to develop a framework for discerning and theorising moments of play in the science classroom. Vygotsky elaborated his theory of play in his essay 'Play and its role in Mental Development of the Child' (1933/2002) and his book 'Imagination and Creativity in Childhood' (1930/2004).

Vygotsky characterises play in terms of involving an imaginary situation and its rules. Through play, imagination is enacted socially and collectively. The imaginary situation created in play is free of constraints of the real situation and allows the child to meet its desires (Vygotsky 2002). Vygotsky (2002, p. 3) writes that play is 'the imaginary, illusory realization of unrealizable desires'. Thus, through play, the child may resist and transcend rules and boundaries of practice set by adults (cf. Halvars-Franzén 2010; Wood 2012). Play thus becomes a way for the child to enact agency in an adult practice—to escape and contest the definitions and boundaries imposed on them. The relationship between play and rules is dialectical. At the same time, as the child transcends rules of practice through play, the rules of play are simultaneously constituted. According to Vygotsky (2002), there is no such thing as play without rules and the child's particular attitude towards them. Whenever there is an imaginary situation, there are rules. These rules stem from the imaginary situation and are always enacted in and changed through play. Rules are a necessary condition for creating an imaginary situation in that the child tells himself/herself in play that 'I must behave in such and such a way in this imaginary situation/game'. Also, every game with rules also contains an imaginary situation: 'It immediately turns into an imaginary situation in the sense that as soon as the game is regulated by certain rules, a number of actual possibilities for action are ruled out' (op cit., p. 7).

Vygotsky (2004) argues that it is not possible to draw a strict line between imagination and reality. Everything created by imagination is based on a person's previous experiences or experiences shared by other people (op cit.). However, children's play is not a simple reproduction of prior experiences but a creative reworking of experiences that are combined to construct a new situation that conforms to the child's own needs and desires (op cit.). Thus, imagination becomes a means of broadening a person's experience because he can imagine what he has not seen and may conceptualise something from another person's narration and description of what he himself has never directly experienced (cf. Ferholt 2007). Lindqvist (1996) elaborated this idea that children develop consciousness in dialogical interactions with adults and peers when encouraged and invited to play in a fictitious world where reality and imagination are dialectically related (cf. Nilsson 2009).

In play, the play situation and reality may coincide. A vital difference between the play situation and reality is that the child in play 'tries to be someone'. To illustrate how a play situation may coincide with reality, Vygotsky (2002) uses an example of two sisters playing sisters. In this play of sisters, the two sisters try to act as sisters and, as part of this, they emphasise the particular characteristics of sisterhood (what it is to be a sister), whereas in real life, they behave without thinking about what it is, or should be like, to be a sister; they just are sisters. Even if the play situation is free of situational constraints, the real situation offers resources for play. An imaginary situation may be comprehended in the light of a real situation, as a recollection of something that has actually happened (Vygotsky 2002). In an imaginary situation, real objects may be put to use and used as pivot objects for play (op cit.). For example, in playing horseback riding, a stick may become a pivot for serving the meaning of the horse. A well-equipped science classroom and an inquiry laboratory setting thus may offer richness in material resources for play compared to other teaching situations. Thus, play becomes an intermediary between purely situational constraints (which the child attempts to overcome) and thought (which is free of real situations).

When students engage in play in the science classroom, they transform classroom practice, as constituted, e.g. in the given tasks, in relation to needs and motives that are personally meaningful to them. Thus, play could offer a way for students to make new sense of what they are dealing with. As we also know that children's play may promote the development of cognition, language and social competence, e.g. self-regulation and cooperation (Nicolopoulou et al. 2009), a scrutiny of play as an integral aspect of activity in everyday classroom practice may gain new insight into the learning processes in science classrooms.

Research Questions

In this article, we draw on classroom research from a larger study on learning, narrative knowing and remembering in IBSE. Hence, we focus specifically on play as it emerges in IBSE classroom practices. Compared to teacher-led whole-class teaching practices, IBSE practices potentially offer students a relatively rich variety of material resources combined with a lesser degree of discursive control (students work in groups where they are allowed to speak more freely with one another). These conditions of IBSE practices may constrain students' spontaneous engagement in play less than whole-class teacher-led instruction.

Given the potential of spontaneous play and imagination for young people's development generally, our guiding research questions are:

- How may students' spontaneous play unfold in IBSE classroom practice?
- How may students' explore ways of relating themselves to science and science education through spontaneous play in IBSE classroom practice?

Methods

Data Collection

In this article, we analyse students' spontaneous play in science classroom practices by making use of data from a naturalistic study conducted in two Swedish compulsory schools (school A and school B). The two schools were chosen as sites in the study on learning, narrative knowing and remembering in IBSE due to their participation in the Swedish school programme for Science and Technology called *Naturvetenskap och teknik för alla* (NTA) [in English: Science and Technology for All].[1] The NTA programme aims to support municipalities in their in-service training of teachers in science and technology-related subjects (for an overview of the programme, see Wickman 2007). In this article, however, we do not focus on the affordances and constraints of the NTA programme as such. Instead, we use this data set to explore students' spontaneous informal play as an aspect of work in science classroom practice.

School A is situated in a residential community and school B is situated in a suburban community with predominantly rental housing. In school A, families have a relatively stronger socio-economic background than families in school B. In each school, we followed one teacher and their sixth grade class during a 10-week period when they worked with an NTA unit called 'The Chemistry of Food'. The class in school A consists of 26 students (13 girls and 13 boys) and the class in school B consists of 25 students (14 girls and 11 boys). The class in school A is taught by a male teacher who specialises in teaching middle school science, whereas the class in school B is taught by a female general middle school teacher. Both teachers have participated in the in-service teacher training associated with the NTA programme and both have prior experience of working with the programme. The intended core content of the unit Chemistry of Food is that humans need a variety of nutrients including carbohydrates, fat and proteins. In all, the unit consists of 12 lessons. Here, we analyse student group work during ten of the lessons where the students work in groups (two to five students) to test if there is starch, glucose, fat and protein in different foods.

Data were collected using video and audiotape recordings of classroom work. In each classroom, seven audiotape recorders and two video cameras were distributed. We transcribed the audiotape recordings verbatim with the video recordings used as support (in all, approximately 55 h of audiotape recordings). All the names used in this article are pseudonyms.

Analyses of Data

Vygotsky's (2002, 2004) notion of play provided the starting point for examining play and/or invitations to play in the studied classrooms. An essential criterion for distinguishing play

[1] The NTA programme was developed, based on the US program 'Science and Technology for Children', by the Royal Swedish Academy of Sciences and the Royal Swedish Academy of Engineering Sciences in 1997.

activity from other forms of activity is the creation of an imaginary situation (Vygotsky 2002). Similarly to Fleer (2008), we define play as when children place themselves in an imaginary situation, with rules, and the children act in association with those rules. For the sake of our analysis, we operationalise play in our analysis as situations where at least one of the following criteria is met:

1. a student tries to act *as* someone other than a student in a science classroom,
2. a student positions a co-student *as* someone other than a student in a science classroom,
3. an object becomes a pivot, i.e. separated from its original meaning and ascribed new meaning in an imaginary situation, and/or
4. a student enacts rules/norms of action that transcend the given classroom tasks.

When analysing play, we are looking for play and invitations to play. We conducted our analyses of data both individually and collectively. Important to note is that invitations to play sometimes fail. Disapproval may be shown by means of silence (non-recognition), by recognition of the invitation without expressed approval or by explicit rejection (cf. the study of social–interactional functions of laughter by Roth et al. 2011). When something is to be understood as play, but is not acknowledged as such, the person inviting may mark a prior utterance by adding, for example, 'I'm just kidding'.

Negotiating Play in the Science Classroom

In this section, we articulate and exemplify students' spontaneous informal play in everyday science classroom practices. We have found that play with science and tasks within the science classroom is an integral aspect of the everyday culture of the studied science classrooms and that the episodes of initiating play include both explicit verbose and subtler wordless negotiation. In all, we found instances of play or invitations to play in 10 of the 26 studied student groups during the unit 'The Chemistry of Food' in the two schools. To illustrate our findings, we use three different episodes to exemplify the processes of invitations to and the unfolding of play. The chosen episodes illustrate both the range of different processes of invitations to play and ways for students to relate themselves to science and scientists. The first episode involves a group of students explicitly negotiating a play situation and also explicitly stepping in and out of the play situation when working with a task to test if there is fat in water. This is simultaneously an example of students imagining themselves as scientists. The second episode is an example of negotiation of play in a subtler manner. It involves a girl and a boy creating an imaginary situation where they position themselves as a doctor and an assistant. The third episode is an example of a girl inviting her group colleagues into an imaginary situation of baking, where the invitation is rejected with arguments referencing situational constraints. This example is, at the same time, an example of a student acting as someone outside of the field of science. The three episodes illustrate a range of possibilities for the unfolding of play and possible imaginary positions for play in the science classroom.

As if… You'd Get Fat from Water

In the following, we account for an episode involving a group of three boys, Lukas, Markus and Erik, in school B. In this episode, the three boys use the idea of not knowing the results of an investigation beforehand as a pivot to establish an imaginary situation. The investigation this particular lesson is about fat in different nutrients. The students are given the task of discussing what they know about fat, making predictions on whether selected food will contain fat and then testing what food contains fat. The materials to be used in the investigation are brown paper (for detecting fat) and different foods and liquids.[2] The substances tested are, for example, milk, water, wheat flour, honey biscuits and apples.

Explicit Invitation to Play

The three boys work with a task to predict and then measure if there is fat in water. Lukas approaches the task by saying that they must make a prediction of whether there is fat in water. Erik responds to this initiative by beginning the negotiation of a play situation.

1. Lukas:	But we must predict, prediction. I think… minus. I don't think it is fat.
	[…]
2. Lukas:	Ahh, here it is. Oops sorry hehehahahe oh oh fat test on liquids. Water is there no fat in.
3. Markus:	Is there, what did you say? Water
4. Lukas:	Wat-, in water there is no fat
5. Erik:	Oh yes!
6. Lukas:	Nope. Hehe
7. Erik:	Or yes in fact, it should do that [contain fat]
8. Markus:	Mm you get fat from it
9. Lukas:	Yes, you get fat from water
10. Erik:	If you drink too much
11. Lukas:	Hehe

In the excerpt, the three boys establish an imaginary situation where it would be possible to get fat from water. Lukas initiates the given task to predict what liquids and dry substances contain fat (line 1). Erik challenges the task alignment by exclaiming 'Oh yes!' (line 5) in response to Lukas' statement that there is no fat in water. With this utterance (line 5), and the following comment 'Or yes in fact, it should do that' (line 7), Erik begins negotiating a play situation. After initial opposition (lines 4 and 6), the imaginary setting is recognised and confirmed by Erik and Markus (lines 7, 8 and 10). Lukas acknowledges the imaginary setting with fake laughter (line 11). The boys then proceed with their practical investigations while confirming the imaginary setting:

12. Lukas:	Okay, now I'll try with water
	[…]
13. Markus:	Oh there, it'll be really
14. Lukas:	*Tadadadantadadatadadadan… I'm the witch's man* [said in English]. *He he.*

The investigation is framed with pretend excitement in relation to the possible outcomes (lines 13 and 14). The play situation is underscored by Lukas saying 'Tadadadantadadatadadadan' and that he is 'the witch's man'. Here, Lukas is positioning himself as someone other than a student working on a science classroom task (perhaps as something like a witch doctor).

[2] The test procedure involves rubbing dry food samples against brown paper and putting drops of liquid food samples on the paper. If the food contains fat a greasy stain will be left on the paper (for liquids, this is the case after the paper has dried).

Stepping In and Out of the Imaginary Situation

The imaginary situation is, however, not taken for granted by the boys during their continuing work:

15. Lukas:	Oh! In water there is fat. I'm kidding.
16. Erik:	You rubbed maybe a bit much I think
17. Lukas:	Yes maybe. Wait, wait I
18. Erik:	Was this here too much?
19. Lukas:	Oh here. I'm just kidding. Hehe it was just a joke.
20. Erik:	Yes but everybody knows that there isn't fat in the water.
21. Markus:	It could be
22. Lukas:	Yes it could. It's absolutely sure anyway.
23. Lukas:	So! Now everyone sees that there is no fat in water.
24. Markus:	But one should still…
25. Lukas:	(inaudible) get the Nobel Prize
26. Markus:	But you should still wait a while Lukas
27. Lukas:	Okay

In the excerpt, Lukas underscores that he is joking (lines 15 and 19). When doing this, he marks the situation as part of a humorously framed imaginary setting. He expresses that he is not to be held accountable for actually believing that there is fat in water. Erik acknowledges Lukas' reservation by his utterance that everybody knows that there isn't fat in water (line 20). With these utterances, the boys step out of the imaginary situation. The imaginary situation is reinstated when Markus and Lukas again say that there could be fat in water (lines 21 and 22) but that they know, as a result of their investigation, that there is no fat in water (line 23). In lines 21–27, Lukas and Markus remind themselves that they cannot know the result beforehand. In other words, that they need to be open to any outcome.

This example is unusual in its explicit negotiation of the imaginary situation. Lukas is explicit in his positioning as an investigator or what he calls 'the witch's man'. The object of investigation and the artefact for conducting the investigation become pivot objects as they are given authority as resources for producing new counter-intuitive knowledge about water and thus, at least partly, are made free of the constraints of the classroom. In this example, there is also an integration of the real and the imaginary situation in classroom practice. The three boys engage in a play of investigating water, which is integrated with their work within the given task. They make use of the tools and objects of investigation to engage in play.

Engaging in Play as Scientists

The boys create an imaginary situation where they adhere to the rule that one has to be open to what the test shows (regardless of prior experiences). The mention of the Nobel Prize constitutes a closure of the imaginary situation. On one hand, this may be regarded as a single, rather fleeting utterance, which is not picked up or elaborated on further by the group of boys. On the other hand, it constitutes a closure of the imaginary situation, thus confirming the boys positioning themselves as scientists within the imaginary situation. This instance could be interpreted as a reminder that big counter-intuitive discoveries are highly rewarded in the field of science (one may receive the Nobel Prize). In doing this, the boys not only display an understanding of the ideas emphasised in science but they also enact resistance in relation to the given school task, requiring them to perform investigations of what the boys in their conversation express to be common knowledge ('everybody knows that there isn't fat in the water'). Their engagement in this investigative play may, therefore, also be understood in terms of a critique of existing classroom practice where what is framed as an inquiry task is in fact a task requiring students to follow a distinct step-by-step procedure disguised as inquiry.

As if… We Were a Doctor and an Assistant

Negotiation of a play situation may be both verbose, as in the prior episode, and more wordless, as in the following episode (cf. Halvars-Franzén 2010). In this episode, play emerges as a subtle process where two students initiate play by use of a slightly different tone of voice or gesture. The example involves Lisa and Gustav, in school A, who engage in play along with their completion of a laboratory task of testing for glucose in different foods.

Invitation to Play

Lisa and Gustav begin initiating a doctor–assistant play in setting up a division of labour; in that way, they deal with the measuring stick and the food to be investigated. They start taking turns measuring with the measuring stick and pouring the food in a cup: 'I'm supposed to pour out and you take the stick'. In this utterance, they state their particular division of labour as an explicit rule of action. The expression 'I'm supposed to' [in Swedish *jag skulle*] is known from interactional analyses of play as a common strategy to negotiate play in preschool (cf. Tellgren 2004). Some minutes later, they switch. Gustav then makes the play situation explicit in a comment on a negative test result saying: 'None of these substances here have glucose. *Is this normal?* No, I'm kidding'. When saying 'Is this normal?' with a lower pitch and more formal tone of voice, he steps into the doctor position of the play. By his subsequent comment that he is joking, he marks his previous utterance as play and again steps out of the play situation.

Acting as a Doctor

The division of labour illustrate how Gustav and Lisa enact rules and norms of action that transcend the given classroom tasks. Ten minutes later, when Lisa takes over the responsibility for measuring, they switch positions and Gustav then explicitly positions Lisa as a doctor:

28. Lisa:	Now I'll do
29. Gustav:	Here doctor (gives the testing stick to Lisa) 30 s

Lisa then puts the testing stick in the investigated food and Gustav counts to 30. Counting to 30 is not part of the task instructions for measuring glucose in the different foods. The counting is another example of how Gustav enacts particular rules in setting up an imaginary situation. In this situation, Gustav and Lisa take turns at positioning themselves as a doctor and as a person assisting the doctor. The stick for measuring glucose becomes a pivot object in this play when Gustav and Lisa use it in order to emphasise the relationship between a doctor and an assistant (line 29; cf. a scalpel provided to a surgeon by a nurse during surgery).

As if… We're Making Dough

An invitation to play is not always successful. In school B, there is one episode where a girl called Vera makes several attempts to initiate play but fails. Vera and two other girls, Jasmine and Anna, are assigned to work together with the task to investigate whether there is fat in some dry substances. When the girls prepare the test of the dry substances, they first moisten the wheat flour, thinking that this is necessary in order to get a result on the brown paper. However, this is an error and the teacher tells them to instead put the dry substances directly on the brown paper. Having made this error, the group lag behind the other groups in class, who finish their investigations when the three girls are just starting up. In the following, we account for the subsequent episode where Vera attempts to initiate play.

Explicit and Implicit Rejection of an Invitation to Play

Whereas Anna and Jasmine, in the course of conversation, express that they want to finish up their work as fast as possible, Vera introduces the idea of dough when commenting on the moistened wheat flower resembling dough:

30. Vera:	Oh, it got like this dough, you know that you…
31. Anna:	It wasn't dough, like
32. Jasmine:	It wasn't dough like I said
33. Anna:	((laughs))
34. Vera:	It became one such dough that you've got when you bake. You need to add more wheat flour.
35. Jasmine:	But then we don't need to get that there
36. Anna:	Yes, okay maybe I shouldn't start
37. Jasmine:	Wait, I will, we need to write on liquids too
38. Vera:	It looks like wheat flour
39. Anna:	I already did, or do you know what I wrote?
40. Vera:	It's one such dough you bake too. Anna, it looks really fun.
41. Anna:	Vera, now we have to work.
	[…]
42. Vera:	It's dough!
43. Anna:	Yes! Yes, yes, yes. I want to get finished (inaudible)

Vera invites her co-students to play by means of making the moistened wheat flour into a pivot object (line 30), thus staging the situation as one of baking. Anna's first response to Vera's invitation to play is one of rejection (line 31). When Vera continues developing the imaginary situation, she is ignored (line 35). In her third and fourth attempts to invite the rest of the group (lines 40 and 42), she is explicitly rejected. Anna interrupts Vera's invitation to play by underscoring that she wants to finish.

About 5 min later, Vera reintroduces the dough when offering Malte, a classmate from another group, a taste of it: 'Malte, taste this! This is, here's bun dough, it's bun dough'. With this call on Malte, Vera extends her invitation to engage in the imaginary situation to a person outside her own group. However, this invitation is met by silence from Malte. Thus, the invitation becomes implicitly rejected. Some minutes later, Anna asks Vera to help out with the practical investigations:

44. Anna:	Do you take the coconut flakes? I'll take this here. Or do you want to take dough? I want to take this here.
45. Vera:	I want to take this here. Anna, it smells [like] buns, I promise it smells [like] buns, smell, it smells [like] buns
46. Anna:	Do you want to take apple?
47. Teacher:	Now, I want you to hurry up girls
48. Vera:	Bun dough. Eva, this here smells [like] bun dough
49. Teacher:	Really, what is it then?
50. Vera:	It's wheat flour

In the above excerpt, Vera makes an attempt to involve the teacher in the imaginary situation by calling on her to recognise that it smells of bun dough (line 48). Vera then continues: 'If the dough lays and rises a little then you can make small buns. The dough has to rise!'. Jasmine and Anna perform the practical investigations and fill in the observation protocol, whereas Vera again calls for the teacher's attention on the dough. Vera repeatedly invites Anna, Jasmine and even the teacher to engage in the dough play by reframing the moistened wheat flour in terms of bun dough and also attempting to establish rules of baking ('it must rise first'). However, she does not succeed at engaging them in the play situation. Anna, Jasmine and the teacher underscore the time frame of their work—Anna and Jasmine express a wish to finish as soon as possible and the teacher asks them if they are done. The dough play is thereby an example of how the set-up of an imaginary situation is rejected by classmates. One interpretation is that a pursuit of the dough play would have been difficult to combine with task completion as the play was sparked by a procedural error, which was not possible to pursue when completing the task. As Anna and Jasmine took charge of the task completion, Vera engaged in the dough play on her own. In addition, the dough play involved the setting of an imaginary situation outside of the science classroom.

The Unfolding of Play in IBSE Classroom Practice

In the three examples previously discussed, play is initiated in different ways. In the first example, Erik, by means of a slightly different tone of voice and by challenging what Lukas states as the obvious (there is no fat in water), initiates an imaginary situation. In this play, the boys both act as others (e.g. the witch's man) and enact rules of action (being open to what the test will show) that partly transcend what is given as a task (predict, measure and record). Their engagement in this investigative play may, therefore, be understood in terms of resisting existing classroom practice where what is framed as an inquiry task is in fact a task requiring students to follow a distinct step-by-step procedure to investigate what the students in their conversation claim to be common knowledge ('everybody knows there isn't fat in water'). In the second example of the doctor and assistant, the imaginary situation emerges as a subtle process. A division of labour initiates the play whereby Lisa and Gustav take turns acting as a doctor and as an assistant. They invent a rule for how to perform the measurement and the measuring stick becomes a pivot object in this imaginary setting. In the third example, Vera initiated play but her repeated invitations to the other students as well as the teacher were rejected. Vera, however, engages in play where she invents rules of fermentation (the dough has to rise) and where the wheat flour becomes a pivot to the imaginary situation. In common for all three examples are that the task resources (measurement instruments, e.g. the stick for measuring glucose, and objects of investigation, e.g. wheat flour) became pivots to the imaginary settings.

The three episodes of students' spontaneous play involved the students transcending various situational constraints of classroom practice. In the episodes where spontaneous play unfolded collectively (the investigation of fat in water and the doctor–assistant play), we find that the students were simultaneously attuned to the constraints of task completion. In other words, the students engaged in play while completing the given tasks. Through play, these students could make new sense of the given tasks within an imaginary situation. In the example of dough play, however, Vera's co-students repeatedly rejected her invitations to play. In one instance, Anna explicitly rejected the invitation with reference to task completion: 'Vera, now we have to work'. The example, therefore, is also an instance of how students collectively engage in task management and where task completion became important for rejecting play in this situation.

Discussion and Conclusions

By pointing to situations in IBSE classrooms, where play emerges as an integral aspect of classroom work, this study contributes to an understanding of the social processes of learning and participation in science classroom practices. In the studied IBSE classroom practice, spontaneous collective play offers opportunities to explore epistemic values, norms of science and different ways of positioning one's self in relation to science (as a researcher, a doctor or an assistant) and the tasks of the science classroom. Our examples of play in the lower secondary IBSE classroom do not only include examples of students positioning themselves as members of a scientist community, but there are also examples of students distancing themselves from the science content of the lesson (as in the dough play).

In this study, we found that the real classroom situations offered resources that became pivot objects for students to engage in play (cf. Vygotsky 2002). The students drew on cultural norms/values and positions of science as well as material resources for investigations (e.g. measuring stick, wheat flour). Thus, through play, the students in these classrooms interpreted their experiences, dramatised, gave life to and transformed what they knew into lived narratives (Vygotsky 2004). In addition, the spontaneous collective play was simultaneously attuned to goals of task completion. Thus, in an institutional perspective, we may not conclude that students engaged in play are necessarily 'off-task'. Rather, this study supports an understanding of official classroom activities as infused with informal unofficial activities, such as play (cf. Maybin 2007).

Previous research has pointed to the potential of play for broadening one's experiences (Nicolopoulou et al. 2009; Nilsson 2009). One idea is that children develop consciousness in dialogical interactions with adults and peers when encouraged and invited to play in a fictitious world where reality and imagination are dialectically related (Nilsson 2009). This is not to say that teacher-led academic instruction should be altered with unstructured free play periods. In a Vygotskian perspective, the teacher, as a competent other (introducing ideas and ways of science), is crucial for learning to become personally developmental to students (cf. Hedegaard and Chaiklin 2005). A challenge for teachers as well as curriculum designers, however, is how to integrate play elements into science classroom practice in ways that allow students to explore different ways of positioning themselves in relation to science and communities of scientists in spontaneous play. Segal and Cosgrove (1994) suggested that teachers cannot be prescriptive, enforcing structured scenarios, rules, concepts or vocabulary. Rather, teachers should participate actively in imaginary situations, by joining in play if invited, suggesting roles, arranging partners and extending students' ways of enacting roles (op cit.). In the vignettes outlined here, the play situations are primarily established amongst the students (in the dough-making play, the teacher is invited but does not verbally respond to the invitation). Also, this spontaneous play is not part of a lesson plan. Based on our findings, it is still an open question, particularly relating to secondary school science, in what ways teachers may actively participate in play situations and what are the affordances and constraints for teacher participation. Thus, further research focusing on potentials for teachers to integrate play as part of science instruction is needed.

In conclusion, imagination and play is a dimension of science classroom life. Our findings contribute to the understanding of how learning in the school science classroom is embedded in social and cultural–historical practice and how individual students through play create opportunities for transforming and transcending classroom practice. Play offers opportunities for sensemaking, opposition and exploration of ways of enacting science identities. Play also offers students opportunities to create situations in the school science classroom that meets their needs and interests. When we analysed our data, a feeling emerged, suggesting that students who do engage in spontaneous play in the science classroom have more fun (e.g. laugh more). However, such aspects of play will need further analyses. Investigating students' trajectories of play in relation to participation and motive development is another issue for further research that may advance science education researchers' understanding of education.

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