Analysing two group-tasks leading to a collaborative classroom practice with Engeström's activity theory

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Two teachers, Olaf and Knut, conducted two group-tasks in succession, early in the academic year at a gymnasium or upper secondary school in Norway. In doing so they steered classroom practice away from traditional instruction, with Olaf alone as teacher, to cooperative learning in small groups with guidance from both. While the first group-task titled *When Together* initiated cooperative learning by students in small groups, the second titled *How Heavy* initiated student groups to build upon group cooperation and work with other groups in a collaborative classroom practice. It was Olaf and Knut's intention to have their students cooperate in small groups at all times and collaborate with students from other groups on occasion. A few months into the year, Olaf and Knut's students' groups had opportunity to discuss rules of cooperation whereupon their collaborative classroom practice became the norm. Using examples of students' attempts at both group-tasks, I portray Olaf and Knut's initiation of such a practice. Using Engeström's activity model I shed light on how students' participation was transformed to meet with their intentions.

Keywords: Group-tasks, cooperative learning, collaborative classroom practice, Engeström's activity theory

Introduction

In this paper I continue reporting from my doctoral and classroom study at an upper secondary school or gymnasium in Norway (Gade, 2006). I summarise instruction corresponding with the first three chapters of their textbook, with respect to four grounded themes in Table 1 below. While my previous effort has been to report on the third cell in the fourth column (Gade, 2013), in this paper I report on the first cell highlighted **in bold**. My focus on group cooperation relating to this cell is in line with the intention of its two teachers Olaf and Knut, to base their everyday instruction on cooperative learning by students. I came to know of Olaf and Knut's intention of having students cooperate in small groups at all times, and collaborate with students from other groups on occasion, in an interview I conducted with them before the academic year began. It was keeping this in mind and my own intention of being participant observer of their classroom instruction, that I shared with them a set of mathematical problems which I thought could be used for such a purpose. It was also the case that at the commencement of the academic year Olaf taught alone, since Knut was on parental leave. Olaf's students were however seated in small groups at all times during instruction. On Knut joining teaching duties, Olaf's prior instructional practice which was fairly conventional until then, was transformed with the conduct of two group-tasks as classroom intervention. Titled *When Together* and *How Heavy*, these group-tasks were built around two mathematical problems I had shared with them, when I commenced participant observation.

Table 1: Progression of instruction corresponding to the first three chapters of the textbook

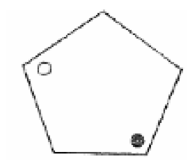
Theme → Chapter ↓	The collaborative practice	The consolidation of meaning	Problem solving know-how	Cooperation in problem solving
Number understanding	Establishment by the teacher of his intentions	Building of meaning in teacher-driven practice	Discussion by turning rules into questions	**Cooperation established, consolidated**
Equations and proportionality	Participation by students in their and other's intentions	Building upon of students meaning making	Building up solutions for application	Students conjecture reality with given graphs
Scale factor in similar figures	Participation by students with independent intention	Building upon of students intuitive knowing	Questions become problems that students can solve	Students question reality with given model

I deploy Engeström's triangular model (2001) to grasp the transformation that Olaf and Knut were able to bring about in their use of *When Together* and *How Heavy* in quick succession. In doing so I treat the conduct of either group-task as an activity system and independent unit of analysis, which when taken together shed light on the transformation that Olaf and Knut both intended and brought about. Roth (2007) argues such analysis to be made up of two distinct layers, one constituting the material aspects of the activity system, with the other clarifying the consciousness of subjects taking part in and for the activity at hand. I argue that such analysis also sheds light on the manner in which Olaf and Knut initiated their collaborative class-room practice in the academic year ahead. How Olaf and Knut utilised two group-tasks to transform instructional practice in their classroom is the question I pursue.

When Together

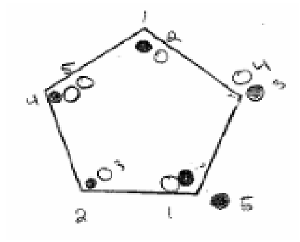
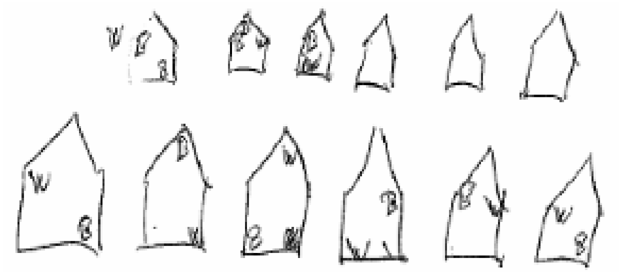
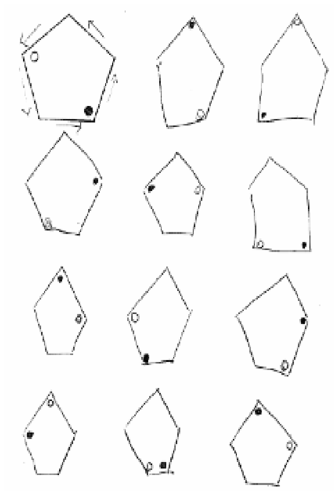
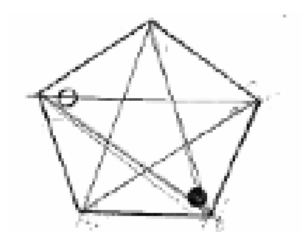
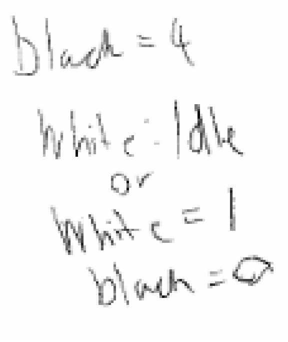
While I do not remember where I came across *When Together*, its wording as handed out by Olaf and Knut to their students is given in Table 2 below:

Table 2: Group-task *When Together*

In the pentagon alongside are two dots, black and white, on the move. The black move two corners counter clockwise. The white moves three corners clockwise. After how may moves are the three dots together	

Olaf and Knut conducted *When Together* on the day Knut joined teaching, by handing out the group-task on separate sheets of paper. They also instructed students to attempt the problem by working in their groups. Subsequent to students' attempts, I collected solutions which I labelled A through F. Of the six student groups, Group A was the only one which had no written solution to hand over. My field notes however record their telling me that their group thought the two dots would never meet. Olaf and Knut also asked students from solutions C and F to share their groups' attempts to their classmates, by demonstrating their solutions on the blackboard. The inscriptions I offer in Table 3 below allow me to showcase how each student group, by inference, attempted the group-task with seemingly different strategies. I also include written explanations where these were provided by student groups themselves.

Table 3: Group solutions to *When Together* - Row 1 (B and C), Row 2 (D, E and F)

<table>
<tr><td>
After the fifth move the dots are back in their starting positions! Answer: They can never meet.</td><td colspan="2">
They hit each other at the first move, but they never end up in the same corner. They land at the point they start after the sixth move.</td></tr>
<tr><td></td><td>
The dots will never meet as they move in the same pattern. When one of the dots catches up with the other, the other one will just move away from it again and this results in an unbreakable pattern. We therefore believe that this is a trick-question.</td><td>

Dots never meet. Black and white dots do get together if the white moves first!</td></tr>
</table>

While I analyse students attempts at *When Together* as various components of Engeström's activity system in a later section of this paper, I presently highlight the fact that the conduct of this group-task initiated students' cooperation with one another within their small groups. While the goal for students in the group-task was to ascertain if the two dots met one another, it was via taking part in this group-task that Olaf and Knut were also able to have students in respective groups cooperate with one another within instruction. It was also the case that student groups used the diagram that was given in the group-task to cooperate, though in one case a bigger pentagon was drawn on a larger sheet of paper, wherein a pen and pencil were moved around instead of the black and while dot in the question. Conducted during a two hour slot of the time-table on Monday, the next group-task *How Heavy* was conducted in a similar two hour slot on the Wednesday of the same week.

How Heavy

I borrowed *How Heavy* from Johnson, Herr and Kysh (2004) who trace this problem to Gardner's (1960) *More Mathematical puzzles by Sam Loyd.* While Gardner's book has a diagram of a bespectacled man holding a huge weighing balance, the group-task handed over by Olaf and Knut was merely a line of text as in Table 4 below:

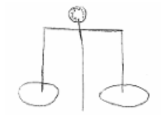
Table 4: Group-task *How Heavy*

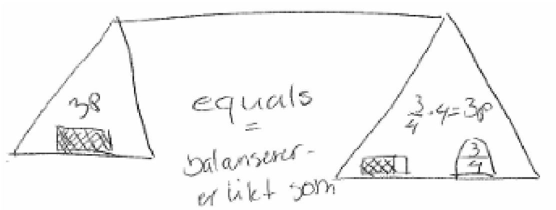
> If a brick balances with three-quarters of a brick and three quarters of a pound, then how much does the brick weigh?

It was with conduct of *How Heavy* that I shifted my role of observing whole classroom instruction to observing individual student groups by sitting beside them. This shift enabled me to view how students cooperated within their respective groups and how each group viewed Olaf and Knut's instruction. As with the conduct of *When Together*, I collected students' inscriptions of their attempts at *How Heavy.* However, unlike distinct solutions collected earlier, it was possible to categorise the solutions as either *Not algebraic*, *Becoming algebraic* or *Algebraic*, as in Table 5 below.

Table 5: Group solutions to *How Heavy* - Not algebraic, Becoming algebraic, Algebraic

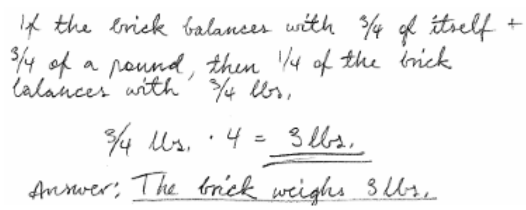
Not algebraic



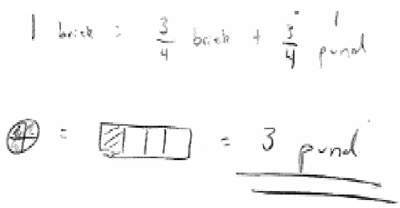


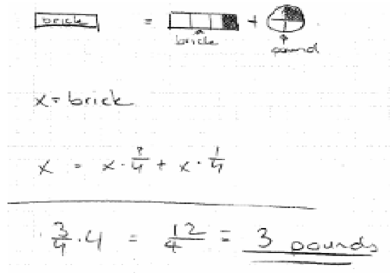
Translation of writing: equals = balancing – is the same as (is alike)

(Diagram includes labelling by researcher of students in Group II)

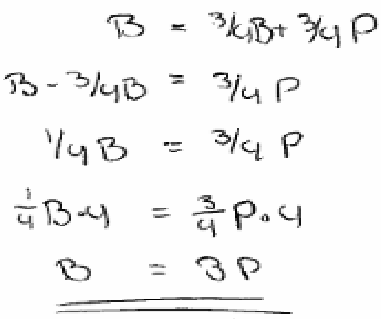


Becoming algebraic





Algebraic



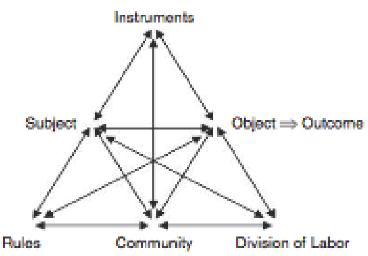
My field notes also record three aspects to coincide with the end of such conduct. First, Olaf and Knut asked a student each from the Not algebraic and Algebraic categories to share their group solutions with their classmates. Second, they thereafter began instruction of the textbook chapter *Equations and Proportionality*. Finally, the conduct of both group-tasks in succession consolidated students' cooperation in small groups, one which became the norm in the academic year ahead.

While analysing the conduct of *How Heavy* as an activity system in the next section, I highlight three aspects which make the nature of its conduct different from *When Together*. Firstly and as is evident from students' inscriptions, this group-task was approached by students by not using the diagram given in the group-task, but by inscriptions they drew to convey their life experiences and mathematical knowledge of algebra to one another. In conveying such thinking they drew balances of different kinds, rectangular boxes to denote the brick or simple algebraic equations. Secondly and soon after the conduct of *How Heavy,* Olaf and Knut went on to connect students' attempts to the mathematical content of Algebra, prescribed in the textbook chapter of *Equations and Proportionality*. Finally it was with the conduct of *How Heavy* that Olaf and Knut initiated student groups to collaborate with one another within instruction. It was such manner of working which led Olaf and Knut to establish a collaborative classroom practice in the academic year ahead, one formalised by rules of group cooperation that students debated and formulated. Displayed on the pin up board in large letters, these rules were adhered to throughout by their students.

Activity analysis

Seven components of Engeström's activity system and model as shown in Table 6 shed light on the manner in which Olaf and Knut transformed instructional practice, via conduct of *When Together* and *How Heavy* in quick succession.

Table 6: Engeström's Activity system



Subject - who is involved
Instruments - tools which mediate
Object - goal motivating participation
Outcome - of the activity system
Rules - norms and regulations
Community - wider environment
Division of labour - distribution of responsibilities

Of the seven components of either activity system, I first list four which were the same in either group-task. In the first the *Subject* or those taking part in the group-tasks as activity systems remained the same, namely students as seated in respective small groups. In the second, the *Rules* or norms of collaboration followed by Olaf and Knut's students also remained the same. In either group-task students worked towards goals as specified in the group-task handed out on sheets of paper. In the third the *Community* or wider social environment in which the group-tasks were carried out also remained the same, with students working in respective groups with occasional teacher guidance. Finally, *Division of labour* or distribution of responsibilities of Olaf and Knut's students in either group-task was also the same in that they cooperated with one another towards solving the problem at hand. Three remaining components of either group-task or activity system were however different. As evidenced earlier on, the problems handed out in either group-task acting as *Instruments* or tools which mediated students' attempts were quite different. While in the first the given diagram of a pentagon with two dots mediated students' attempts, in the second it was a variety of inscriptions made by students themselves which conveyed personal understanding of the problem at hand. The *Object* or goal of each group-task which motivated students to participate was also different. While the first asked students to ascertain if the two dots met, the second asked students to ascertain the unknown weight of a brick. Finally the *Outcomes* of the group-tasks were also different. While Olaf and Knut's students cooperated in the *When Together* for the first time within instruction and for a non-routine task, in *How Heavy* they consolidated group cooperation in their respective groups. The content of the latter was also explicitly linked by their teachers to their mathematics textbook. Thus Olaf and Knut's explicit instruction to cooperate within one's group in the first group-task had become implicit by conduct of the second, one effectively utilised to externalise personal meaning being made about the weight of brick. It is such analytical insight that sheds light on the twin layers Roth (2007) draws attention to. First there is the materiality that constituted the conduct of *When Together* and *How Heavy* as group-tasks. Second there is the nature of consciousness that was demanded and exhibited by Olaf and Knut's students as they participated as subjects towards the particular objects of either.

In conclusion

Tharp and Gallimore (1988) argue the task of schools is to create activity settings in which children's minds and/or consciousness are roused to life. In the limited space available in this paper I argue Olaf and Knut's conduct of *When Together* and *How Heavy* to be one such setting. Importantly, this setting drew on active negotiation of meaning and intersubjectivity by students, one which became basis for formulating rules of group cooperation and taking part in the collaborative classroom practice (Gade, 2011). In its ability to analyse instructional activity, Engeström's (2001) model allows me to shed light on how Olaf and Knut's conduct of either group-task was distributed across various constitutive components. It was the outcome of these in quick succession that allowed Olaf and Knut to establish and teach in a collaborative classroom practice and reality, one which was very much their intention.

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