

# CHAPTER 6 BALANCING STRUCTURE AND FLEXIBILITY: TEACHER'S ORCHESTRATION IN COLLABORATIVE LONG-TERM INQUIRY

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## Introduction

In collaborative inquiry learning, the aim is to engage students in collaborative work on varying complex problems and exploiting collaboration. The aim is to support handling the ideas and knowledge as items continuously to be improved and raise the students' own ideas and questions to the centre of classroom work process (Scardamalia, 2002; Zhang, Hong, Scardamalia, Teo, & Morley, 2011). When the teacher aims to implement collaborative inquiry practices, she/he needs to tolerate openness. The process and the object of inquiry are designed in collaboration with students, thus the outcome of the inquiry cannot be fully known beforehand; neither the phases of the process, nor the content to be studied. In addition, the tension between the demands of student responsibility and these novices' lack of competencies in carrying the inquiry autonomously puts the teacher in a position where she needs to balance between structuring the project and leaning flexibly on ideas emerging in collaboration. Consequently, the challenge for the teacher is to orchestrate the inquiry process and practices where the students are utilizing their own ideas and strengthening their own community, and promote sustained, collective, pedagogical settings in which idea improvement is the central focus rather, than specific learning tasks or activities (Zhang et al., 2011).

The present account of our investigation reports a collective inquiry project carried out at an ordinary elementary-level school focused on investigating cultural artefacts over a one-and-a-half-year period. The project took place in Laajasalo Elementary School, Helsinki, Finland, and lasted three terms, beginning in the students' second term of fourth grade (when students were 10 or 11 years) and continuing across 13 months until the end of their fifth grade. In the project, 32 students participated. The aim of this chapter is to depict the teacher's longitudinal process; her balancing challenge between structure and flexibility in order to support the students' authority in collaborative inquiry practices. We also define how the teacher's reflecting built and shaped the collaborative inquiry process.

To a great extent, the present collaborative inquiry project relied on the high degree of the teacher autonomy that is typical in Finnish education (Hargreaves & Shirley, 2009). In Finnish educational system, the National Core Curriculum for Basic Education highly values teachers' pedagogical knowledge and skills, and provide teachers the flexibility to implement subject contents and design their own local curricula (Sahlberg, 2011). The teachers' involvement in designing provides higher engagement for development of their teaching and pedagogy (Sahlberg, 2011). This also creates possibilities for teachers to implement integrative projects including several school subjects.

## Balancing between teacher- student –lead, between structure and flexibility

In efforts to raise students' ideas to the centre of discussions, and to support their taking responsibility for the process, the teachers inherently face “the dilemma of reconciling the goal of respecting children's thinking with the goal of helping them acquire ‘conventional’ knowledge and procedures” (Cazden 2001). Simultaneously with expecting students to take responsibility for their own work, they have to be deliberately guided to follow certain rules and standards, such as setting up productive research questions and making plans of inquiry (Olson, 2007).

Supporting students' generation of their own ideas and promoting collaboration within a classroom community is not possible without supporting routines and structures that channel the students' activities in a way that elicits participation in inquiry. However, having too rigid structures may undermine inquiry efforts altogether. If the teachers prepare or follow strongly scripted curricula or fixed routines, their own creativity and ability to respond to the specific needs of certain classroom are limited (Roth, 2002; Sawyer, 2004). A scripted approach clearly specifies tasks and learning activities, the order and form they should take. In scripted teaching, the teacher is the one who controls the flow of the class, limiting when students can talk and how much impact their statements can have on the collective encounters (Sawyer, 2004). The scripted approach is an example of strong framing (Bernstein, 1975, see page xx) with an associated instructional discourse that gives students very little choice and responsibility. The problem that occurs in too strict external performance requirements is that participants can implement given tasks without assuming their own authority rather than engage in genuine inquiry; tasks are done under direction, rather than with self-direction (Dillenbourg & Tchounikine, 2007; Lakkala, Muukkonen, Paavola, & Hakkarainen, 2008; Ng & Bereiter, 1991; Scardamalia & Bereiter, 2005; Zhang et al., 2011).

Several results (Hmelo-Silver, Duncan, & Chinn, 2007; Mercer & Littleton, 2007; Rogoff, Goodman, Turkanis, & Bartlett, 2001; Sawyer, 2004; Scardamalia, 2002) support the idea that most effective teaching gives students freedom to participate, interact, experiment, and construct their own knowledge. In this kind of classroom, the teachers may be prepared by planning, longitudinally, overall aims and setting up the learning resources that could be used; yet the actual, enacted curriculum will only approximately resemble what has been planned (Roth, 2002). Along the same lines, Sawyer (2004) called for improvisational teaching, where the teacher needs to work together with students and respond to their unique needs (Sawyer, 2004). This requires ability of the teacher to notice the teachable moments, and to build on the unique situations the students bring to

the curriculum, taking account of students' own initiations (Roth, 2002; Sawyer, 2004; Zhang et al., 2011).

Many researchers have been emphasizing (Lakkala et al., 2008; Sawyer, 2004) that the most effective classroom interaction will balance structure with flexibility and improvisation. This means that the teacher needs to have a repertoire of lesson structures and teaching styles from the continuum, where on the one end learning activity is merely teacher-focused and on the other end, students are autonomously driving the learning (Barker & Borko, 2011; Cazden, 2001). Thus, effective teaching gives students freedom to construct their own knowledge, while providing and shifting between carefully chosen elements of structure; these include scaffolds, activity formats or pedagogical frameworks that support the co-constructive process (Sawyer, 2004). The shifts themselves are the teacher's improvisational responses to the unique needs of that class and those students (Sawyer, 2004, 2011).

In this study, we use the concept of orchestration as a metaphor for defining the teacher's deliberate efforts, as an agent, in designing, planning, managing, and enacting collaborative inquiry processes (Littleton, Sharples, & Scanlon, 2012). In the next section, we will describe "The Artifact Project – the Past, the Present, and the Future" that was carried out at an elementary-level school. Its aim was to engage pupils in creating both new conceptual and material artefacts in collaboration with one another (Seitamaa-Hakkarainen, Viilo, & Hakkarainen, 2010). This intervention was inspired by the knowledge-building and progressive inquiry approaches which aim at engaging both teachers and students in building new knowledge and understanding (Bereiter & Scardamalia, 2003; Hakkarainen, 2003; Scardamalia 2002).

## Context for the collaborative inquiry learning setting

"The Artefact Project" was designed together with the class teacher and researchers, and it took place in her classroom. The teacher has been very committed to developing the pedagogy of progressive inquiry, and she has extensive experience as an elementary school teacher. She has also functioned as a provincial pedagogical ICT support teacher. Although the present investigators and the teacher had regular planning and evaluation sessions during the project, the latter was responsible for adapting plans in practice. The researchers and teacher together designed the general theme and the affording pedagogical infrastructure for the project, but the actual plan emerged through interaction. We wanted the students to come up with their own ideas concerning how to study artefacts and design various learning activities and field trips with the teacher.

The project covered, in time, about 139 lessons (one lesson lasts 45 minutes) during three terms, and it integrated many school subjects, such as history, mother tongue, science, design, and technology education. The technical infrastructure for the project was provided by Knowledge Forum (KF), the networked learning environment (Scardamalia, 2002). In the project, the students were asked to analyze artefacts within a cultural context. In the first phase - The Past - the historical investigation of artefacts and their functionalities were carried out. Each student team chose the history of one type of handheld artefact, i.e., ball, clock, jewellery, lamp, lock and key, money, and

spoon, for investigation; the students' ideas drove the historical investigation. The selections were made among the real objects they used daily. In the second phase of the Artefact Project – The Present – the students investigated physical phenomena of artefacts, such as movement of a ball, functioning of a lamp, light, and characteristics of metals. They were guided to ask questions and carry out their own scientific experiments as well as those based on pre-given science tool kits. The third phase of the project – The Future – was conducted under the leadership of a professional designer and teacher; the participants designed lamps and future artefacts in teams. The design process was carried out in teams, by sketching, drawing, and building prototypes or models.

Knowledge Forum (KF), the networked learning environment (Scardamalia, 2002) supported the process. KF is a database consisting of knowledge in its visual and conceptual form, created and organized by the participants. By authoring *notes*, the students contribute ideas, theories, working models, reference material and so on, to *views*, which are workspaces for streams of inquiry. The KF thus represents or gives form to what we call the 'object' of inquiry.

Our research relies on the data collected during the longitudinal study project. In the present chapter, we depict the teacher's process with the help of video recordings (in total 56 lessons) and the teacher's diaries. The teacher filled one project-diary template, including both a structured part and a reflective part, several times in the weeks during the course of the project. Table 1 lists the content of the diary template. Investigators received the filled templates once in one or two weeks. In the structured part of the diary, teacher was asked to describe the all of the activities done in her class for the process. The reflective diary guided the teacher to reflect on the issues that she considered important at the writing moment.

Table 6.1 The content of the teacher's project diary template

The structured diary	The reflective diary
<ul style="list-style-type: none"> <li>• time frame</li> <li>• location of the activities,</li> <li>• the social organization of the activities,</li> <li>• the activities of the inquiry process,</li> <li>• the tools that were used to support the activities</li> </ul>	<ul style="list-style-type: none"> <li>• How were activities organized?</li> <li>• What themes and contents were addressed and how was the inquiry developing?</li> <li>• How did the community function</li> <li>• What was the role of technology supporting the process.</li> </ul>

For the video data, we developed a theory- and data-driven qualitative content analysis (Friese, 2012), that was employed systematically (Chi, 1997; Kelle, 2006). We selected all those whole-class activities with the teacher's guidance or teacher's and students' joint discussions, but excluded the Future phase from the analysis, because the teacher remained background and the professional designer carried the main responsibility of guiding the students design process. Our interest was in the two perspectives: (1) *Responsibility for sustaining the inquiry*, and (2) *Type of activity*. In the responsibility for sustaining the inquiry, we noticed that the episode were either a) *collectively developed* (when the whole-class community together made initiatives how to continue), or b)

*teacher promoted* (when the teacher urged on, encouraged, and facilitated the proceeding of the inquiry and the whole class participated, e.g., the teacher urged students to create deepening working theories and question, or facilitated interlinking new inquiries with their previous wonderings), or c) *teacher focused* (when the teacher took the main control of how to continue, e.g., give guidelines for making KF-notes, or provided a task for sharing the results of inquiry). To continue, the activity in the episode concentrated either on a) *planning*, (e.g., creating research plan in collaboration, or discussing how to build up a KF view) or b) *reflecting on procedure* (e.g., discussing how to observe an artefact or evaluating observations); or, alternatively the activity concentrated on c) *developing content of inquiry* (e.g., creating collective classification for artefacts or creating deepening working theories).

## The teacher's longitudinal process during the knowledge creating inquiry

In order to depict the teacher's strategic efforts in long-term orchestration of inquiry, we selected the three whole-class episodes for scrutiny using the following criteria: a) the teacher's strategic reflections and background of the activities were available through the reflective diaries; b) the episodes characterized a trajectory (continuum) of pursuing the longitudinal, object-oriented inquiry although not always immediately following one another; c) each episode represented one of the three different ways of pursuing and sustaining the inquiry (collectively developed; teacher promoted and teacher focused). The episodes are selected from the Present phase of the project in which the participants studied physical aspects of the artefacts that had been selected for examination in the Past phase of the project. Teacher diaries will be used to make her background work visible.

### Example 1. Organizing knowledge building notes

As the first example, we will address an episode in which the teacher was leading students to pursue an inquiry about light. The episode took place after the students had constructed their initial working theories and questions in the Knowledge Forum regarding the main question, "What is light and how does the lamp produce its light?" The teacher's orientation to the episode was shaped by her earlier evaluation of students' questions and theories in the KF:

"I decided to do a new view [in KF] named 'lamp and related phenomena' for the purpose [i.e., make specific theories and questions for answering the main question]. Theories were written. I read the theories. I was thinking that they should somehow be organized, because the view seemed to be rather chaotic. The theories were still quite superficial."

In order to attract students to deepening inquiry, the teacher invested efforts to engage students themselves in planning how to make Light View in KF more comprehensive. Hence, the following episode represents an activity where the whole class is *collectively developing* the inquiry and *planning* how to continue. The example indicates that the teacher's assistance was important to enable students to participate using their own initiative. The whole class was gathered around a

shared screen to reflect on knowledge built in Knowledge Forum (see also Figure 1):

Teacher: .../Well, I put our main page [i.e., KF view] on display and we'll look at what you've done during last week. I think that, we really need to think about how we're going to proceed from this, but you might have some previous experience of dealing with situations like this, and I think that now we should think together as a group, how to go forward from here as you have put up your theories on the view from the lamp and the phenomena related to it. This is the kind of work we have ahead of us. What does this look like? What does it look like? When there is so many of them [KF-notes], they are coming forth little by little. What do you kind of first impressions does this give you? Michael?

Michael: It's quite confusing.

Teacher: So it appears to be.

Tom: There is now a big pile of work.



Figure 6.1 Three-picture-series illustrating example 1 and its continuity: a) The students' initial working theories in a messy view (left), b) Anna has a suggestion, and c) The note to be organized.

In order to orient the students to plan what to do next, the teacher invited them in reflecting on the previous inquiry activities. As seen from the above transcription, the students were pointing to the same chaos (Figure 1a) that the teacher referred to in her diary. Because the students remained a bit passive, the teacher engaged them herself in discussing deepening inquiry:

Teacher: Previously we have had these kinds of big projects, if you remember anything about the Pohjola (Nordic) project, or from the early phases of the Artefact project where we had this kind of large amount of information in front of us. What did we do then? And what can we do now? With this kind of pile of data? Suggest something.

I'm going to put up [write down] some ideas that come to your mind. Ethan?

Ethan: To sort them.

Teacher: Ah. Sorting is a good start. Other ideas? Theo?

Theo: Sorting them in rows.

Teacher: Sorting them in rows. Anything else? Anna?

Anna: Mind map.

Across the discussion continuing beyond the above excerpt, the teacher collected and documented students' ideas that emerged. They continued the same event by discussing how to organize the notes. They ended up following Ethan's idea of organizing the notes according to their core features. Following examples of earlier phases of the project, "utility" and "purpose" were also used as a basis of categorization. The teacher concluded, "Will we be fine with these ideas? Well let's look as we open these, what else will come out and we need to get it up there to the title so they'd differ." The following excerpt reveals that the participants had become inspired in the activity:

.../ Lara: I was just thinking that, we could probably get it organized easier if we hold the shift key and press activate everything in the other area and move them somewhere lower.

Teacher: Ah, yea.

Lara: Then it would be easier to organize.

/...[A volunteer was searched for (Lara) to organize notes. Students where pointing notes to be organized].../

Teacher: Thank you, Lara. Great! And what about next? Well, there is nothing for it but to open them and look what we find.

Tom: Let's start with the upper one.

Teacher: Okay, good; let's start with the upper one.

Pointing to the shared screen, the students started making various suggestions regarding how to proceed. One student started to organize some notes about light in the front computer with the help of others. There emerged an atmosphere of genuinely mutual engagement. Although the teacher was the one who asserted that everyone should now open the notes, she suggesting something that aligned with Tom's comment "Let's start with the upper one," rather than issuing an order. Subsequently, they started to discuss the content of the inquiry, open the notes, and examine them:

.../ Teacher: In the dark you can't see anything [**concluding the previous thoughts**]. What about in the light. That's the meaning. We can't see without light. We need light to see. [**commenting again the issue from the KF-note reflected on the shared screen, reading the new issue**]: Well this is all well said, light lights the darkness. You can move it from place to place. [**commenting the student note**]: Well, that is those lamp businesses. [**reading partly and commenting the next issue from the note**]: But light can be... what does it depend on or does what determines if a light is bright or dim? What causes it? What causes it, children? Michael, what do you think?

Michael: (unclear) Fire requires oxygen which it then burns and then requires more energy. The less it's in use the dimmer it is.

Teacher: Yea but what question does that answer? Now it's so that, we need to think up new questions. Who hasn't said anything yet? Everybody with raised hands has already said something. Tom?

Tom: Well, it answers the question that what a lamp needs to be.

Teacher: Well, now we need to do so that, I'm going to put a new subject there, so what kind of light there is. Good. There. /...

The previous excerpt shows how students were opening the notes one at the time, putting their own ideas at the centre of discussion and analyzing them further, and categorizing the notes under self-made subtitles. Students were able to participate in the creation of the organizing procedure though the teacher helped mediate the discussion. During the discussion, the KF was used as their on-time developing object, one that externalized their thinking on the shared screen. At the end of the episode, after they had modelled the organizing procedure together, the teacher organized the students to continue working, one or two team members at the time.

The teacher wrote in her diary, afterwards, addressing a number of questions generated by students and emerging through interaction with the teacher:

30.9. We were examining what kind of notes had been done. We were organizing notes under the headings that we had created together. At the same time, we were considering what kinds of questions the notes were answering: Where does the light come from? What is producing the light? The source of light. What is light? How can the light be used? What is light like? Burning.

However, in the collective episode that followed the diary entry about their questions, the teacher took a promoting role in sustaining the inquiry. There the teacher had collected all the previously organized student theories in the same document and placed them again on the shared screen; she wanted the students to reiterate and deepen the question-explanation process in teams. Her reflections after that *teacher-promoted* episode indicate that she had not been satisfied with the progress of the project:

2.10. I urged them to wonder and make more in-depth why-questions. I remember explaining that the theories were not yet detailed and deeper-level enough. More wonderings, questions and deepening questions were collected and commented in teams. Now we were getting deeper into things. The questions started to become more detailed and focus on some specific phenomena related to light. In fact we discovered many-sided things about light, and the groups chose themselves a topic that they wanted to start to study. I let the teams choose their topics by themselves, which was a little risky in my opinion, because I was a bit bothered about whether or not the students would choose the kind of questions that would help them to learn the essential aspects from physics. I don't really know, what I would have done, if the students' decisions would have been completely "off".

After the re-iteration of the question-explanation process, she was satisfied and let the students choose their research topics themselves. She was relieved that the students were able to come up with relevant questions without too much direction from her part.

## Example 2. Connecting the next experiment to earlier student wonderings

Based on the theories organized in example 1 (above), the students later created their own research



questions to be investigated in their light and electricity experiments. The following episode took place after students were carrying out some light experiments they had designed. For addressing questions and theories regarding electricity (i.e., how to make a lamp light), the teacher provided students ready-made electricity tool kits. In her diary, she described her background preparations concerning the electricity studies, which were based on their earlier knowledge building in the KF and evaluated how the first part of experiments succeeded and advanced their inquiry:

6.11. I asked the Lamp-group which of the productions [**created at an earlier stage of the project**] could be brought into the new view and then we worked according to the group's suggestions. /.../ We figured that all of the things from the spring would help if necessary, in allowing us to return to what we had previously learned or thought about. While conducting experiments, at the same time we would constantly keep in mind the questions related to the lamp and how it functions."

"While reading the students papers I realized that most of them had written about the tools that were needed (support) according to my question (What is needed? How is it done?). The papers also showed attempts to demonstrate through illustration a little bit on how the tools should be combined with each other. We couldn't get any deeper, so I immediately realized that I need to try to "pump" the students for more.

In accord with the teacher's analysis, above, the students had been reporting and elaborating their findings from their experiments in the KF. The following example took place after the diary entry above, and represents a *teacher promoted* episode, where the students were actively participating in *developing the content of inquiry*. In the episode, the teacher capitalized on notes that the students' had earlier produced to the KF so as to deepen their inquiry. As she reflected in her diary entry above, she apparently had an idea of what they could achieve through their inquiry. The episode started with recollecting previous inquiry activities. The teacher asked the students to think back together the issues they have already built up in the KF based on their previous experiments. She gave feedback on how well they had succeeded in making circuits and initiated discussion regarding what is required to make light. The students, however, responded by listing pieces of necessary equipment. This allowed the teacher to initiate discussion of necessary elements and arrangements of circuits. She continued the discussion by referring to student's (Theo) drawing of a circuit:

Teacher: [**searching Theo's note from KF and opening it**] So what was it about the system that, like over here Theo said that the power is conducted. And Theo already talks about how [**reading the note aloud**] "the power circuit doesn't conduct energy if the power circuit isn't closed". What does it mean? What do you mean by that?

Theo: It means that plus and minus go into one another.

Teacher: Yeah, but where does it go and how?

Theo: It goes so that there goes a cable from the minus end to the lamp and from the lamp a cable goes to the plus end.

Teacher: So you mean that something happens inside the lamp? Well, what happens in the lamp?

Theo: Well, the current goes through it.

Teacher: Well how can it go through? What transports it?

Theo: Well it's there. It's trying to get to the minus end all the time.

Teacher: What does it transmit along? What's inside the cable?

Theo: Copper wires.

Teacher: Good. Now we're at the heart of the issue. So there's something inside the wire.

The above transcription reveals how the teacher started by asking clarifying questions and focusing Theo's remarks towards addressing the issue of what is happening inside the wire. At the end of it, the teacher referred again to the Theo's note (see also Figure 6.2) and concluded: "And so Theo started to be here interested again in what conduct the electricity." Right after that moment she decided that they would all look together at information sources related to electricity and examine existing light bulbs. Some students had already read information sources shared through the KF and assisted the teacher in finding the right pieces of information at the shared screen. When the teacher asked what they saw in the visual representation of bulb and in the actual bulb, the students responded in ways similar to that of Michael: "Steel wire.. and then the wire in a way wears out .. burnt so that it is no more bright" supplied a ground for the teacher to connect the formal, subject-matter concepts to the findings: "You see that the glow is only in one place. There. It is called a filament wire. It glows when current goes through." Finally, the teacher organized an experiment for deepening ideas that students had presented in KF: "Today we will try to make that filament glow. An experiment. So we'll see how the current flow happens...."

Although the previous example was *teacher promoted*, the entire whole-class episode was, however, built on the student's sketchy ideas that had been elaborated and deepened across time. The teacher's promoting was needed because she was the only one who was able to recognize the cognitive value of the students' initially very fuzzy thoughts of the conduction of electricity, a phenomenon that was totally new for them.



Figure 6.2. Three-picture-series illustrating example 2 and its continuity: a) Theo's open note in the shared view, b) The group of students trying to make filament glow, and c) The lamp and electricity experiments view at the end of the thematic phase

The previous process continued after two episodes related to electricity experiments, with a short *teacher focused episode* where the teacher gave guidelines for continuing. During that episode, she went back to the previous KF discussion regarding electricity and continued: "You have probably now seen that some materials conduct electricity. And they can be divided in conductors and insulators. But then, ... how it happens inside the electric wire, should be explained. Now I thought that you could think what happens inside the cable. What is needed for the flow of electric current? That you would very carefully explain what happens inside the cable." Finally, she shortly gave

guidelines about how they should first discuss the issue (in teams) and then go to the KF and explain their thoughts. Afterwards, she described her own expanding role in her diary:

Because the students had not gone further in their explanations on the functioning of electric currents, I put another question onto KF based on researcher's advice, next to the picture drawn by the students for the first assignment. What happens inside the electric cable? I gave students some sources where they could find explanations for the observations that they had made: I suspect that the read information, combined with observations, led the students to understand the phenomena that lead to the light turning on.

The fact that the students read each other's explanations and clearly made comments building on each other's comments, probably contributed to how they understood things.

According to the teacher's reflection, her central role in structuring the classroom activities enabled students to deepen their process meaningfully.

Although the previous teacher-promoted and teacher-focused episodes might look like ordinary practices of classroom teaching, it is critical to notice that the whole-class episodes were embedded in longstanding trajectories of building on the students' ideas and inquiries. The initial ideas and questions were formed in the Past phase; these ideas were elaborated and specified in the beginning of the Present phase and deepened further across the previous examples, with the teacher guiding the way. Furthermore, it is important to keep in mind that between the whole-class episodes the students always continued advancing their inquiries in teams. Knowledge Forum acted as a link that mediated the process between the students and the teacher. Without the teacher recognizing the promising paths based on the student's KF notes, the students would very likely have only scratched the surface of the phenomena.

## Concluding remarks

The present chapter defines a collective inquiry project carried out at an ordinary elementary-level school. We focused on the teacher's orchestration and balancing between structure, where she guided students in appropriating routines and practices of productive inquiry, and flexibility, where she searched for possibilities to lean on students' own authority for continuing inquiry. We depicted how the teacher's personal strategic reflections built and shaped the collaborative inquiry process. Knowledge Forum supported participants' efforts by integrating the students' and teacher's longitudinal inquiry process.

In the background of the process, the teacher prepared herself for the subsequent collective activities by reflecting on the process achievements and the enacted classroom situations. She created aims and plans regarding how the process could be continued and sometimes searched for suitable pieces of equipment, designs of science experiment, or knowledge needed for deepening inquiry at subsequent stages of the process (see also Viilo, Seitamaa-Hakkarainen, & Hakkarainen, 2011). She also constructed KF views, often relying on the earlier phases of the inquiry, for

structuring and guiding the process, and facilitating advancement of inquiry through collective examination of previous achievements.

In the enacted collective activities, the teacher's understanding of the inquiry practices, in conjunction with constant assessment of project achievements, created the basis for focusing the process and the possibility for the improvisational enactment collectively. Three types of collective working episodes were used regarding responsibility for sustaining the inquiry in practice. Firstly, there existed episodes in which the teacher and students were equally involved in developing the inquiry. In these episodes, the strategic plans and goals of the project were determined jointly between the teacher and students although the teacher often needed to facilitate and nourish the discussion from her side. Secondly, there were episodes in which the teacher deliberately either promoted discussions towards suitable strategy for further inquiry, or pushed idea improvement towards a level of understanding that the students would not have been able to reach themselves. Such teacher promoting was needed when students' were not able to express their own ideas or when the classroom discourse did not lead in a direction that would have assisted in obtaining higher-level project objectives. Thirdly, there occurred teacher focused episodes where the teacher considered it necessary to directly lead the community into using appropriate inquiry strategies or to reach a deeper level of explanation.

Knowledge Forum functioned as an instrument that stored and mediated the participants' initiations and ongoing inquiry process turn by turn. In the present case, use of system fostered students' authority by putting their own initiations and ideas at the centre of discussion and further improvement. It enabled the longitudinally emergent knowledge advancement where the members were trying to build on each other's turns, creating elements that were novel to them. Knowledge Forum enabled activating previously created knowledge, bringing it into the centre of attention, and using collective remembering of past processes and outcomes of inquiry to support joint reflection regarding how to advance and focus subsequent inquiry efforts.

However, creating the desired classroom culture that would promote the collaborative inquiry requires time and efforts. The whole collective with the teacher needs to develop methods of socializing both, the students and him/herself to the evolving collaborative culture and embodying the principle of student authority (Gresalfi, 2012; Hakkarainen, 2009). Crucial in the success of collective work within a classroom community is supporting practices, routines and specification of social and technical elements that support and channel the students' activities in a way that elicits participation in the inquiry (Bielaczyc, 2006; Zhang & al., 2011). The teacher is the heart of supporting this culture (Hakkarainen, 2009) and orchestrating the interplay between different activities and social processes in the changing learning situations.

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