Planning for Thinking and Cognitive Development of Students

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Abstract

Schools around the world are trying to cope with rapid societal changes – fast progress of technical development, the globalization of communication, markets, and ideas, and the demand for equal education for different groups in society. If these challenges are to be met, for the benefit of mankind, it calls for good educational practice in every classroom, focused not only on teaching thinking to students, but also as on their abilities to make productive choices, and to take responsibility for societal development in the future.

This paper presents a thorough investigation and analysis of current research literature on how education can meet the demands for cognitive development of students, compared with results from observations and teacher interviews, recorded at 65 lessons in classrooms with students from grade K-12. The question guiding the analysis concerns what criteria are important when teaching good thinking to enhance the students' cognitive development, and how these are planned by the teacher and represented in the classrooms.

The 'thinking classroom' presupposes that the teacher plans, assesses, chooses activities and tools, and arranges the setting carefully, with strong focus on fostering students' habits of mind, rather than fixating on factual knowledge or covering of certain knowledge areas. The contextual and communicational interactions play a vital part of support in a thinking environment. These criteria were used when analyzing the results. However, evidence of he anticipated criteria were difficult to ascertain in the observed classrooms. Though most teachers showed an understanding of what would develop the students' cognitive skills, they lacked the understanding of how to translate their theoretical knowledge into practice.

Key words: thinking, creative abilities, cognitive development, lesson planning

Introduction

Schools around the world are trying to cope with rapid societal changes – fast progress of technical development, the globalization of communication, markets, and ideas, and the demand for equal education for different groups in society. School curricula frequently stress the necessity to develop students' thinking skills and abilities as well as their creative capacities. When asked, teachers state that they actively try to promote students' thinking. But a closer look at the practice in European classrooms shows that teachers rather require that students remember or reason from previous experiences (Sokol, 2012). Students are given few or no challenges or systematic tools to develop their own analytic or creative thinking. Schoolwork is often centered on teaching aids and is highly subject specific, reproducing rather than encouraging critical thinking or innovation, and with the teacher as sole receiver of the product (Pihlgren, 2013). The teacher dominates by talking 70-75% of the time and by posing questions where the answers are given (Liljestrand, 2002). The students have little influence on the activities in the classroom and tend to avoid intellectual challenges.

What is valued as 'good thinking' has through history been defined differently (Pihlgren, 2013). In modern society 'intelligence' is an ideal, often used synonymously to good thinking abilities. But critics have stated that intelligence rather will become what the intelligence tests are able to measure, in other words, what we wish it to be. Recent research on intelligence shows a broader theoretical base than the earlier mostly psychological, and spans many disciplines, including neurology, anthropology, pedagogy, biology, and philosophy. This broader base and wider span opens up new insights and interpretations of the concept of intelligence. By investigating a vast amount of contemporary research, Howard Gardner (1999) has found that there are different brain dispositions, giving several different intelligences rather than one: linguistic, logical-mathematical, bodily-kinesthetic, musical are some examples. According to Gardner, the intelligences are neutral potentials that either will or will not be activated, depending on the values of the surrounding culture, the possibilities given, and the personal decisions made by the individual and/or the family, teachers, and others. According to his theory, intelligence is formed both by genetic predispositions and by context. All individuals carry the potentials, but to different extents, and the combinations and outcomes will be highly individual. The potentials will be mobilized and connected depending on the needs and cultural preferences. Creativity, as intelligence, has historically been considered genetically constituted, but is dependent on the surrounding context, as well as on personal abilities like ambition, talent and will (Csikszentmihalyi, 1996).

In recent years the amount of research focusing on how thinking can be developed by systematic activities has grown rapidly, as has cognitively based research on how learning is connected to successful thinking and to creativity. The brain uses two systems to solve problems and to learn (Björklund, 2008; Kahneman, 2011). An explicit system helps us to analyze information and remember things while we work or solve problems (Klingberg, 2011). An implicit system stores data from experiences on a subconscious level (Björklund, 2008). People tend to use the more impulsive and intuitive implicit system to avoid the effort of using the explicit system when confronted with tasks demanding logical thinking (Kahneman, 2011). However, the implicit memory is more sustainable and will be reliable if the bank of implicit memories is large (Björklund, 2008). Complex learning takes longer and requires incubation, pauses from learning.

Research on good thinkers or experts within their field, for example scientists and artists show that experts have a rich experience and understanding of their subject and its established knowledge base (Björklund, 2008; Willingham, 2009). Critical thinking includes elements of creativity and independence or it would not be possible to make the connections needed to make evaluating and analyzing conclusions (*Uppsala University*). Creativity does not seem to be possible without a base of knowledge (Csikszentmihaly, 1996; Lindström, 2006), nor without a systematic and conscious approach (de Bono, 1998). However, the teacher cannot wait for the students to learn all the facts and skills needed to think like an expert. The student will learn to think productively and creatively by being given the opportunity to attain and practice good habits of mind (Gardner, 2009; Pihlgren, 2008). Good thinking supports learning and good thinking needs to be practiced and trained systematically during the whole school period.

Intelligence seems to be the result of an individual combination of unique biological dispositions that can be developed and refined, presumably in school. The teacher will have to meet with several challenges when trying to teach the students productive thinking: Balancing what is valued in society with teaching critical thinking and creativity, coping with traditional expectations on what a

classroom context and a qualitative lesson ought to be, and considering how thinking, intelligence, and creativity are developed. Underlying theoretical ideas will most likely result in different interpretations of what should be done in the classroom. There are few practical role models to turn to, when teachers try to find a pedagogy for the future. Research during the later part of the 20th century has rarely focused the complex didactic processes going on in classrooms (Kroksmark, 2006). This paper will explore how the teachers cope with some of the challenges of teaching good thinking.

Questions, theoretical base, and method

The paper analyzes how education in schools meets the demands for cognitive development, particularly critical thinking and creativity of students. Research literature is compared with results from observations and teacher interviews.

Research questions

The questions guiding the analysis have been:

- *What criteria, according to research literature, are important when teaching thinking to enhance the students' cognitive development?*
- *How are these represented in the observed classrooms?*
- *How do the teachers describe the considerations they make when planning?*

Theoretical base

All teachers act in their everyday school practice from a more or less explicit pedagogical "praxis theory" (Pihlgren, 2013). This is often a concoction of experiences in the classroom, teacher training, examples from others, and in time expertise. At least three main groups of theories affect practice in today's classroom (Pihlgren, 2011a): the behaviorist, the maturity, and the interactive. The interactive theory (cf. the tradition of Vygotsky) and the maturity theory (cf. Fröbel, Montessori, Steiner) see the learner as active (Pihlgren, 2011b), as opposed to the behaviorist view that individuals will learn when tempted by rewards or in fear of punishment (cf. Pavlov, Skinner). In the behaviorist tradition, learning and maturing is more or less considered to be the same process (Carlgren, 1999). In the maturity tradition learning is taking place as an effect of the student maturing. In the interactive theory base, the student will learn in interaction and thereby mature and develop.

The researcher strives towards proficiency in a research area, and uses the theory to expand his/her knowledge by looking through a specific theoretical lens. To the teacher, on the other hand, observation and analysis are part of the continuing work to assess every student's learning, and how the student's experiences and thinking can be guided (cf. Shulman, 2004). The teacher will have to master many different theoretical tools to see solutions to the practical problems and challenges that occur in the complex school context or the teacher's praxis theory might lead him/her to mechanically solving all students' problems in the same way with limited success.

Depending on how theories are interpreted they might either support the teacher's intentions to teach all students to think, or not. The way psychological research fifty years ago described the

population's intelligence as a bell curve[1] led many teachers to think that a fixed number of students would have capacity to reach higher grades, an idea that in its essence is the opposite of school's mission to accomplish good education for all. Gardner's (1999) idea that individuals prefer different learning styles because of their dominant intelligence has been criticized because it has led to the deterministic idea among some that students learn best by only using one mode, giving the student fewer possibilities to explore other possible intelligence areas (Willingham, 2009)[2]. Teachers with different praxis theories will probably stress different didactic aspects.

Method

Observation and teacher interviews were recorded during three years in five schools in Sweden and Slovakia[3]. 65 lessons taught by different teachers in different classrooms grade K-12 and in a variety of subject areas were observed, each for approximately one hour. Each teacher met with the researcher the same day for a one hour interview, where feedback on the observation notes was given and discussed. Written notes on this discussion were recorded after the meeting.

Observation notes were taken using a chart where every new sequence in the observed lesson was recorded, stating time, actions, and observed outcomes. Contextual information was noted. The cognitive content in each sequence was assessed, using Bloom's revised taxonomy for learning, teaching, and assessing (Anderson & Krathwohl, 2001), see table 1. In contrast to Bloom's (1956) classic 'Taxonomy of Educational Objectives' the revised taxonomy analyzes the content from two dimensions: A *knowledge dimension*, highlighting what type of knowledge is being focused: factual, conceptual, procedural, and meta-cognitive; and a *cognitive process dimension,* displaying the thinking operations asked for: remember, understand, apply, analyze, evaluate, and create. The two dimensions result in twenty-four positions, all used and equally important in the teaching process, according to Anderson & Krathwohl (2001). The work was limited to the teacher's choices connected to students' thinking, not investigating the cognitive processes within each student.

The result was analyzed from criteria from the literature section and the theoretical base and conclusions were made about consequences of teacher praxis theory on planning and teaching actions, and structure, control, and intellectual challenge.

All teachers consented to participate and could at any time refrain from participation. The observations and feedback sessions were part of the participating school's development program, and the schools were given an overall report on their results, but particular lessons or individual teachers were not specified. In this paper, all names of teachers have been changed to guarantee anonymity.

In Slovakia two observers took notes and some of the teacher interviews were carried out with help of a skilled interpreter. The observer inevitably makes choices, especially in the complex classroom context, where hundreds of micro-events happen almost simultaneously. Marking the taxonomy

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[1] Cf. a normal Gaussian distribution.

[2] There is no consistent evidence that learning styles exists, as opposed to the different intelligences (Hattie, 2012).

[3] Some of the material has already been presented in Pihlgren, 2011a, 2011b, 2012, 2013.

meant making choices and interpretations. Important material might have been lost. All the same, interesting results have been highlighted. The participating teachers were aware that the observations were evaluative. Keeping this in mind, the result will probably show what they were capable of doing at best. The result cannot presume to be valid in all schools. However, the material is extensive and points to important trends for others to investigate further.

Literature

School constitutes a particular context in society, with rules and codes to interpret, an "open" curriculum describing what is expected intellectually, and a "hidden", non-explicit, curriculum, involving expectations of certain social behavior (Broady, 2007; Jackson, 1990). Every school embraces a school code, where patterns of thought, interpretation and actions guide work and social life (Arfwedson & Lundman, 1984; Hargreaves, 1998). In the classroom intellectual activities and conventions compete – it is hard to reach high cognitive quality and keep all students active at the same time (Carlgren in Jensen, 2011). Indirect learning content, the contextual signals, and the direct learning content, the subject taught, influence the results. Students' performance in school depends highly on their ability to interpret codes and their willingness to adapt and change their own social code to that of school (Bergqvist in Carlgren, 1999; Lindström et al, 2003; Rosvall, 2012; Trondman, 1994; Virtanen & Kourelahti, 2011). The system the teacher uses has to be visible to the students if they are to participate actively (Andersson, 2012). An unclear system building on students' self control might be beneficial for the students who can decode the system, but not to others (Bernstein & Lundgren, 1983, Stensmo, 2000). Responsibility will enhance students' self motivation, and the ability to accept intellectual challenges (Hattie. 2012).

The role of the teacher

The teacher's ability is vital to students' success (cf. Chetty et al, 2011; Hattie, 2009; Jensen, 2005; McKinsey & Co, 2007). Teaching is a cognitive ability, acquiring extensive experience (Willingham, 2009). Not all teachers reach the level of expertise. To succeed helping all students, the teacher will have to take responsibility for the subject content, the activities, the results, and for the social relations in class (Kindeberg, 2011). When teachers prioritize activating the students, or their wellbeing, the class shows poor learning outcomes (Marshall, 1988). Teachers who act as intellectual role models, use intellectual concepts, display their subject's intellectual qualities, and arrange equipment show improved student results (Alawad, 2010; Ritchhart, 2002). The successful teacher works systematically with students' ongoing relational processes (Tholander, 2002; Wretlander Bliding, 2007) to create a community of learners, where all participants sees themselves as partners in enhancing learning and understanding.

Students learn from experiences, storing implicit memories and everyday concepts, connected to context and situation (Arevik & Hartzell, 2007; Björklund, 2008; Hattie, 2012; Jensen, 2005). However, it is important that students experience the same specific learning object from a variety of angles (Marton, 2006) and that the teacher goes beyond the practical experimenting to analysis and higher level generalization, to force the students to think explicitly about their experiences using advanced concepts (Arevik & Hartzell, 2007; Dewey, 1997). This means engaging the students in challenging and hard cognitive work, and in thinking meta-cognitively (Hattie, 2012; McGregor, 2007). Students are often unable to transfer knowledge from one area to another (Willingham, 2009), but meta-cognition will help them (Hattie, 2012). Students develop and improve their thinking process by being made conscious of how they think (Hattie & Timperley, 2007; McGregor, 2007). To

encourage students to reflect meta-cognitively the teacher can construct thinking-charts, where the task is sequenced with recurrent meta-cognitive questions (Kimbell & Stables, 2008). Working with thinking-charts or portfolio, where student products are collected during the processes, gives the students the opportunity to experiment, get feedback, and learn from experiences, with good effects on learning and creativity (Lindström et al., 1999; Willingham, 2009).

Classroom dialogue

The ideal pedagogical dialogue is an activity directed towards discovery, new understanding, and learning, and is held in a non-authoritarian fashion, with many participators (Burbules, 1993; Dysthe, 1996; Holquist, 2004; Mc Gregor, 2007). Open ended questions are particularly important when fostering intellectual abilities (Billings & Pihlgren, 2009). The more concepts the student can use to describe the process of thinking and the core of the subject, the more he/she will develop knowledge and abilities within the area (Perkins, 1992; Ritchhart, 2002).

The reflective dialogue differs from traditional classroom communication. It takes time for the teacher and the students to adapt and the roles of the traditional classroom will remain at the beginning (Billings & Fitzgeralds, 2002; Liljestrand, 2002). Students talk more of the time compared to in a traditional classroom, but subjects tend to focus the teacher's priorities, frequently presented as if they were society's values (Liljestrand, 2002). If the teacher handles dialogue and rules in contradictory ways it will risk the intellectual content (Haroutunian-Gordon & Jackson; 1986, Liljestrand, 2002; Pihlgren, 2008). However, if reflective dialogue is used systematically, the dialogue will promote intellectual and social development (Pihlgren, 2008). When students interact with a mutual goal at hand, they learn more effectively (Björklund, 2008; Jensen, 2011), if their levels of development don't differ too much (Williams, 2001). Group activities are less effective when students don't have to cooperate to reach the goal (Jensen, 2011).

Planning and assessing

Factual knowledge is seldom remembered, instead interactional and thinking patterns help sorting out unimportant information (Gärdenfors, 2010; Ritchhart, 2002). Complex and authentic problems will therefore promote learning more than simplified tasks, as will thematic subject integrated education (Noori, 2011). It is important that the teacher focuses on questions that the students don't know the answer to (Sokol, 2012). To be challenged on an appropriate level has shown to be more important to students' motivation and learning than tasks within their interest areas (Noori, 201; Willingham, 2009). To be able to develop creativity, students should be given time to deepen their knowledge and have the opportunity to examine, explore, experiment, revise, and reflect on their work (Csikszentmihalyi, 1996; Hetland et al., 2007).

The teacher will have to change from planning what facts to teach to a more elaborate way of focusing on what concepts the students will have to acquire to think abstractly (Erickson, 2007; Gardner, 2009). Facts and concepts are interrelated (Erickson, 2007), but facts can be taught without advanced thinking, whereas abilities and understanding cannot develop without systematic cognitive training (Ritchhart, 2002). Starting lesson-planning by focusing on an area, central to human conditions, and on what should be the result of the taught area, will make it easier to chose central concepts, abilities, facts, and activities that will be appropriate to gain the desirable results (Wiggins & McTighe, 2011). Integrating thinking routines in everyday work is more effective than using designated thinking lessons (*Visible thinking*, 2012). The routines aim at making thinking visible and

at building mental scaffolds to integrate as methods. Different tools – brainstorming (*Visible thinking*, 2012), mind-mapping (Buzan, 2006), lateral thinking (de Bono, 1998), story-lining (Willingham, 2009) – help the students to visualize, group and regroup, construct, and design. Activities where conflicting materials are interconnected have shown to be effective when helping the brain to remember (Jensen, 2005; Willingham, 2009).

Teachers often use student assessment to foster proper student behavior, with no or little cognitive results (Granath, 2008; Hofvendahl, 2006; Mårell-Olsson, 2012). Using formative assessment, where the student get feedback on the present level of knowledge, the goal, and the way to get there, have high impact on students' learning (Jönsson, 2011; Hattie, 2011). However, not all feedback is effective. Feedback on personality, or as test scores, show little effect – the grade is seen as the goal and directs the student's attention to their own (lack of) ability and away from the task (Hattie & Timberley, 2007; Perkins, 1992; Willingham, 2009). Feedback on process has the greatest learning impact (Hattie, 2009). The more challenging the task is, the more the student will seek and welcome the feedback. The student will learn to assess by systematically meeting a variety of methods, where the teacher gradually introduces the student to what are important criteria and how assessment is done (Hetland et al., 2007; Lindström, 2006). This includes teacher giving feedback, self-assessment, peer-assessment, and discussion of assessment in class. Assessment has to be taught – even university students have difficulties assessing their work or interpreting the teacher's assessment without support (Bek, 2012).

Conclusions from literature

Students should have time to make implicit experiences from a variety of angles, gradually taking them to generalized knowledge by challenging explicit cognitive work, training them in analysis, meta-cognition, and formative assessment. Teachers' planning should start in identifying central areas and desired results. Open dialogue and goal focused student interaction affect the cognitive outcome positively. Actions should focus on thinking and helping the students to uncover thinking patterns by presenting complex and authentic problems where the answer is not self-evident. Using thinking routines and contextual mediation will help the teacher to promote thinking and creativity. The teacher has to take responsibility for all activities going on in the classroom to create a 'community of learners'. The more open the curriculum, the fewer students' rejections or provocations. However, school has its own culture, affecting the outcome.

Results

The results are presented from three angles: knowledge and cognitive dimensions, classroom dialogue, and the plan and structure.

Knowledge and cognitive dimensions

Overall in the observations, 717 lesson sequences were noted, resulting in more than 10 000 marks in Bloom's revised taxonomy (cf. Anderson & Krathwohl, 2001). The frequencies in the positions differ. Table 1. shows the percentage of markings made in the total material of marks.

Table 1. *Frequency of markings in positions of Bloom's revised taxonomy in percentage of the total material of marks.*

THE KNOWLEDGE DIMENSION	THE COGNITIVE PROCESS DIMENSION					
	1. Remember	2. Understand	3. Apply	4. Analyze	5. Evaluate	6. Create
A. Factual knowledge	12	11	10	4	4	2
B. Conceptual knowledge	7	6	6	2	1	0
C. Procedural knowledge	8	8	11	2	1	>1
D. Meta-cognitive knowledge	2	1	1	<0	<0	0

Remember, understand, and apply factual, procedural, and conceptual knowledge are the most frequent activities. These nine grey marked positions were activated in all 65 classrooms. An example of this is Mrs. Dagny's lesson:

Excerpt 1[4]. *Mrs. Dagny introduces letter writing to students in 7th grade, English lesson.*

1 Mrs. Dagny: What were we doing yesterday? /*she writes 'formal and informal letters' on the board/*
2 Do you write letters? Do you like writing letters?
3 Class: Uhum, yes, no /*laughter*/
4 Mrs. Dagny: What are the pros and cons when writing letters? Compared to using your cell phone?
5 Maria: It takes longer.
6 Mrs. Dagny: Right, it takes a longer time! /*she writes 'I love U' 'waiting 4U' on the board*/
7 Let's start a letter, Hi Amy /*she writes on the board as she speaks*/ please continue
8 Ivan: 'Can we go out darling?' /*smiles*, *some laughter in class*/
9 Aleš: 'Meet me at the cinema'
10 Mrs. Dagny: Good, I now want you to write your own letters to a friend. You should include 'by the way' and 'anyway' /*writes on the board. The students pick out their books and start writing*/.

The students were asked to remember and understand factual knowledge, applying this to writing letters. Few concepts were discussed or introduced. Mrs. Dagny started an evaluative sequence (pros and cons, line 4-5) but as she didn't continue, the cognitive intention changed to asking the students to remember facts.

Cognitive activities evaluate and create are noted in some lessons, but not in others. There are very few examples of notes in the meta-cognitive knowledge dimension, and exceptionally few in analyze, evaluate, and create meta-cognitively, all notes there were taken in three of the 65 lessons. One of these exceptions is Ms. Jana's lesson:

Excerpt 2. *Ms. Jana's lesson Physics lesson o Newton's third law with students in 12th grade.*

[4] The excerpts have been shortened and/or summarized to facilitate the reader's understanding.

The students arrive and find a thinking-chart placed on each desk. They immediately start answering the first question: 'What do you know about Newton's laws?' From a written instruction and some material placed in each group the students continue experimenting with forces working on different bodies for 20 minutes. After a while, they're asked to answer the second question of the thinking-chart: 'What do I want to know?' The experimenting continues and they are told to document on post-it-notes. Each group then reports their findings and hypotheses to the rest of the class. Ms. Jana asks several questions to the groups: 'How did you see that? Why do you suppose this? Could you explain to the rest of us what the consequences would be?' After all groups have given their accounts the findings are discussed and the post-it-notes are sorted on the board, supported by the teacher's questions: 'Which ideas goes together? Why? Which ideas seem contradictory? Why? What do we know now? What don't we know?' The students take notes in their notebooks. At the end, Jana presents a situation where the law doesn't seem to apply, but without explaining the situation. Finally she asks the students to answer the last question of the thinking-chart: 'What have I learnt?' She also asks them to prepare questions for her next session, when she will be lecturing on Newton's laws.

Ms. Jana's lesson hits all positions in the taxonomy except create procedural and meta-cognitive knowledge. Most of the talking was done by the class, Ms. Jana worked almost entirely by posing questions, except for some short directives.

The older the students were, the more hits were noted in conceptual knowledge, and to some extent in the analyze process column. However, it's important to note that activities concerning everyday and advanced conceptual knowledge equally made marks in the conceptual column. The younger the children were, the more activities were registered in applying and creating factual and procedural knowledge, with few or no notes of meta-cognitive knowledge, analyze, or evaluate. This was also true for practical-aesthetic subjects with older students. An example is Mrs. Maita's class in Mathematics to students in 1st grade:

Excerpt 3. *Mrs. Maita's lesson in Mathematics to students in 1st grade.*

Mrs. Maita has gathered the students in a circle on the floor. She introduces a material of beads – single beads, bars of tens and squares of hundreds – and introduces cards, on which the beads can be used to add and subtract. She shows how this can be done and then asks first one of the students and then all to repeat the actions. The students try different ways of performing the task while discussing the results, and helping each other. Mrs. Maita then informs the group that they now might work with their personal choices. Some of the students restore the bead material to its containers and go on to use other material; others continue working with the beads.

Mrs. Maita's introduction focused on how to apply the procedural knowledge of using the beads, rather than how to add and subtract. The students were then free to change the activity.

In interviews, teachers could state the knowledge they had aimed at, even though the actual outcome often seemed to target more or, in some cases, different knowledge aspects than they stated. When asked to explain what cognitive processes they had planned few could answer, even when helped by the taxonomy and the interviewer. Almost all teachers showed great interest and fascination when seeing their lesson noted and analyzed, and a very common comment during feedback was 'I didn't realize I did all that!'

Classroom dialogue

In a majority of classrooms where teacher talk dominated, the notes would be mostly concentrated to the grey marked positions (see table 1), with few exceptions. In some classrooms the degree of student talk was estimated to half of the talk time or more. A few of these would, as with Ms. Jana's lesson above (excerpt 2) cover most positions of the taxonomy. However, the larger group of these, nine of fourteen lessons, was more comparable to Ms. Maita's lesson (excerpt 3), where the students continued experimenting, making their own choices throughout the lesson, marking fewer positions.

The positions marked were highly connected to the teacher's quality of questions. Activities inspired by questions where the teacher intended a certain answer, or piloting the student towards a certain idea would be noted in the grey area (cf. excerpt 1). When the teacher introduced open-ended or scaffolding questions, encouraging the student to analyze, interpret or value, the following activities would hit positions outside the grey area. Meta-cognitive questions were exceptionally rare, used by only a few teachers systematically, as a way to take the lesson further (cf. excerpt 2).

Most teachers seemed to take factual questions as an established way to teach students. The interviews showed that few teachers were familiar with meta-cognition as a concept, even if they could see the difference between factual questions and meta-cognitive questions, when pointed out during the interview. The few teachers who introduced meta-cognitive questions were not conscious of doing so.

The plan and structure

Almost all of the lessons followed a predictable, traditional structure: The teacher motivated today's subject, then introduced new knowledge that the students practiced individually and/or in groups. The lesson ended by the teacher summarizing, and handing out homework. Mr. Stefan's lesson is an example (and excerpt 1):

Excerpt 4. *Mr. Stefan's lesson in Religion to students in 10th grade.*

Mr. Stefan introduces that today's lesson will be on the transition from Jewish religion to Christianity in ancient Jerusalem, and specifically about the events connected to Good Friday. He shows a short instructional film, where the main information is presented. Groups of four students are asked to recapitulate the film: 'What were the main causes of the transition? How can they be explained in a historical context?' The students discuss for 10 minutes while Mr. Stefan passes among the groups, answering questions or shortly participating in discussion. He then holds a lecture on how the construction of the Jewish temples supported the underlying assumption that only the rabbi could enter the inner part and meet God. He presents some pictures of the temple as illustration and then asks the students to read a text and answer the question: 'What are the consequences of the earthquake, when the tombs break open, and the curtain in the temple is torn from top to bottom?' The students work in silence for some time and the teacher circulates to help and to observe results. At the end of class Mr. Stefan asks the students for their answers and finally repeats the main information, and class is given the text as homework.

Observation notes show that some students lost interest – even if the content is complicated, the lesson hardly marks any positions except the grey area in the taxonomy. This lesson structure was predominant in three of five observed subject integrated themes.

Some of the observed lessons show a different structure, starting in students' experiences, through analysis taking students from their everyday assumptions to generalized knowledge. Excerpt 2 is an example of this. However, some of the observed lessons never ended in visualized analysis (also cf. except 3):

Excerpt 5. *Mrs. Kristina's lesson in Physics to students in 6th grade.*

When the students arrive after recess, the teacher Mrs. Kristina has filled the room with balloons. They float over the tables and fall to the floor. Mrs. Kristina encourages the students to experiment with the balloons and they start to throw the balloons up in the air and to each other, stepping on the chairs and tables to find out how long it takes for balloons to fall. Soon, someone sticks a balloon to the ceiling by rubbing it. This inspires the students to try to stick the balloons onto different surfaces, while they laughingly discuss the results and potential explanations to why it works or not. Mrs. Kristina observes the process, sometimes supports by handing out material, sometimes coaches to further explorations by asking questions. The playful activity goes on for 20 minutes. Mrs. Kristina then asks the class to summarize. Each experience

results in a question: 'The balloons stayed "glued" to the ceiling when rubbed but not otherwise. They didn't stay there forever though. Why do the balloons stick and why do they eventually fall down?' The questions are noted by the students and in groups of two the students choose a question. They will now try and find answers to the question on their 'personal choice' work time.

Mrs. Kristina's lesson marks some areas outside the grey in the taxonomy. The students are encouraged to create and to some extent analyze, but analyses are not evaluated and there are no meta-cognitive discussions. The students might still foster everyday interpretations that are inadequate or wrong.

Very few teachers seemed to use the material, the furniture, or the room decoration for contextual mediation. The rooms seemed to be furnished in a certain way, and the teacher didn't change this, even when the furnishing didn't support the activity. With three exceptions, classrooms for students in grade 7-12 displayed few signs of what subject was taught. Classrooms for younger children often displayed students' products, and more signs of what was considered important – letters, figures, maps. However, the interviews showed that many teachers had problems explaining why they chose certain artifacts or furnishing, often referring to school policy or collegial decisions.

The interviews show that teachers in general were aware of the importance of letting students experiment and analyze, but most teachers considered time to be too limited. The teachers using the common lesson structure seemed to take for granted that this was how lesson planning is done. They would more or less plan from what had been taught the previous lesson, and referred to the next lesson content in terms of what areas were to be covered, rather than what processes or abilities that would be trained.

The teachers using the different structure explained this as a conscious chose. Mrs. Maita (excerpt 3) was inspired by Montessori pedagogy and explained that she introduced new material shortly to the group or to individual students, and that they would make use of it when they had reached the appropriate level of maturity. Her didactic plan started with observing the children, and went on to present learning opportunities to the student. To her, the material, rather than the dialogue, was of vital didactic importance to support the development of the student. The group of teachers presenting lessons which hit a more extensive part of the taxonomy (e.g. excerpt 2), started their planning by consulting the curriculum, and planned interconnecting activities. An example is a teacher team planning the thematic project 'Systemae Necesse Est', focusing man made systems in general and the periodic system in chemistry in particular:

Excerpt 6. *Mrs. Sofia's lesson introducing teacher team's thematic unit on systems to students in 10th grade.*

The week before starting, the students have been getting "clues" in their e-mailboxes: Pictures of the card game "Funny families", their own schedule for the week, and "The element song" by Tom Lehrer. The first day Mrs. Sofia starts with a thoughtful discussion, where students are asked to analyze and compare maps over the same area: of the pipes underground, the electrical cords over ground, and where the Halloween pumpkins were placed one Halloween. Mrs. Sofia then invites the students to a table, with a lot of measuring instruments. They will now, in pairs: 'create a "class" with "categories" where everyone in our group is measured, measure, display your results so that everyone can use them'. Afterwards she asks the students to reflect on their choices and the difficulties they experienced. They are then presented to the task that will be their main assignment during the rest of the thematic project: 'In groups of 3-4, find and display graphically/digitally a system of 3 classes that claims to explain more than the classes do. A slide show with examples of different systems is shown. The groups of students are asked to discuss their first tentative ideas, construct mind-maps on what they know, and formulate questions they have about systems, particularly the periodic system. Some of these questions are asked during the next session, when Mr. Håkan, the chemistry teacher, lecture on the periodic system. When

the day ends, the students are given homework to prepare for tomorrow's thoughtful discussion on the periodic system. They will also meet Miss Ulrika in a drama session, dramatizing the periodic system.

This plan is more complex than the others, using longer time slots, and integrating different subjects. The didactic plan starts in puzzling the students, and then gradually forces them through different experiences, analyzing and generalizing these. It gives students opportunity to create and investigate on different levels of knowledge and understanding. The activities address meta-cognitive knowledge, and analyzing, evaluating, and creative cognitive processes, aiming at teaching the students habits of mind. Context and dialogue are used to challenge and motivate the students to engage in the project.

In some classrooms, where the structure was unclear to the students, the structure in itself seemed to cause disorder. An example is Ms. Jessica's circle-time in K-1st grade:

Excerpt 7. *Ms.Jessica's circle-time in K-1st grade.*

1 Ms. Jessica: Good morning */some children are sitting in the circle; others are not/* please start counting 1, 2, 3
2 Class: 4, 5, 6, 7, 8, 9, */goes on counting. Jessica goes to the next room to collect students and put them in the circle/*
3 Class: 245, 246, 247… */Jessica returns, standing outside the circle/*
4 Ms. Jessica: Sh…
5 Class: 252, 253, 254 */goes on counting, most students look at Jessica/*
6 Ms. Jessica: Hush now, let's start the lesson
7 Amanda: I thought we had started!
8 Philip: Boring */he starts moving out of the circle gradually/*
9 Ms. Jessica: Quiet Philip, please move back into the circle */points at the spot he has just left/*

The activity will eventually, 15 minutes later, end in an outdoor task. It is hard to see the point of the circle unless it is part of training students to adapt to school discipline. When the system was easy to decode, the order was kept, if the teacher controlled the events (cf. excerpt 1, 4), or if the students recognized the structure well enough to make their own decisions (cf. excerpt 2, 3).

Analysis and conclusions

The literature shows some important criteria that promote thinking and creative cognitive work. Some concerns conscious teacher planning and teaching actions: time for students to explore and analyze, formative and meta-cognitive training, exploring and analyzing dialogue, help student's form thinking patterns by making thinking visible. Some concern structure, control, and intellectual challenges: actions and context focused on learning, challenging work, an open curriculum creating a community of learners. These criteria were used when analyzing the results.

The material shows some differences between schools, possibly the influence of a school code, but the differences between lessons in the same school are bigger. Mrs. Dagny (excerpt 1) and Ms. Jana (excerpt 2) work within the same school and present different approaches with very different results concerning cognitive quality.

Consequences of praxis theory on planning and teaching actions

Most of the observed classes were thoroughly planned and well performed. The analysis reveals four teaching styles: the common, the student investigative, the scaffolding, and the moralistic teaching style. Their didactic consequences are displayed in figure 1: Position A. *Didactic position* where the intention is to plan both product and process, B. *Process oriented position*, where the intention is to

plan the process but not the product, C. *Maturity position*, where the outcome, product, is planned, but not the process, and D. *Chaotic creative position*, where neither is planned by the teacher.

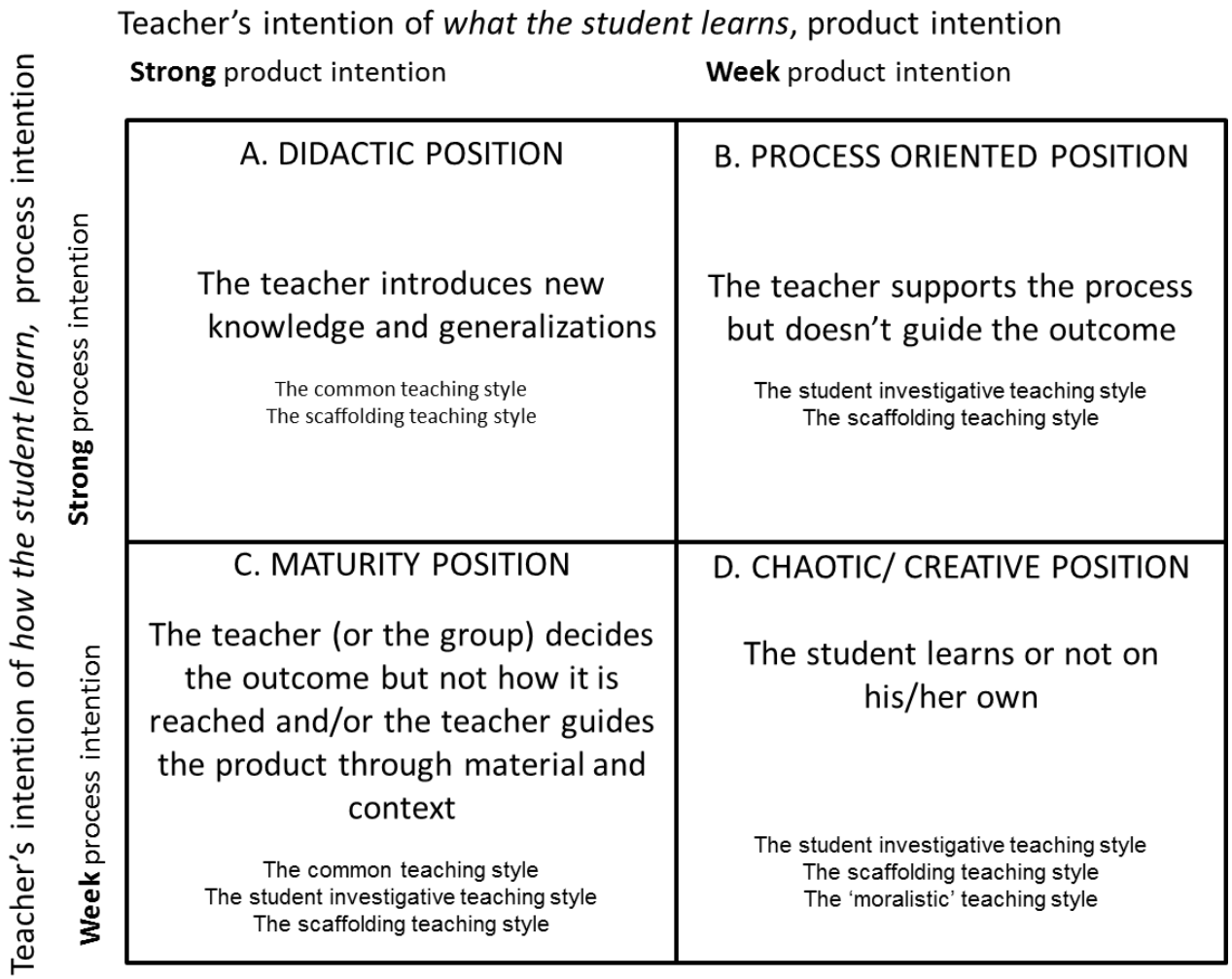

Figure 1. Didactic analysis of four different educational planning styles.

The common teaching style

The common lesson plan (cf. Mrs. Dagny, exc. 1; Mr. Stefan exc. 4) reaches to control the content of what is to be learned and does so by planning the student process closely, by using several different tasks and methods, most commonly lecturing (position A). During group discussion, task, and home assignment, the choice of process is up to the students (C). The intention is to evoke an understanding of new knowledge, and then gradually strengthen this by using short motivational elements, probably necessary to keep the students' attention, since the object of learning is not obvious to them at the beginning of the lesson. The knowledge and cognitive processes initiated are concentrated within the grey area of the taxonomy. The dialogue in this style is controlled by the teacher most of the time, and questions are focused on evaluating the students' knowledge or memory of what is being taught. Few or no challenges are put to the students and few attempts are made to actively scaffold students' thinking or experimenting or to let students explore and create. This plan is closely related to behaviorist theories (cf. Hunter, M. *Instructional Theory in Practice*).

The student investigative teaching style

Classes for younger children, or in practical-aesthetic subjects, tend to show another planning structure, starting in position C by introducing new material that will help the students to develop (cf. Mrs. Maita, exc. 3; Mrs. Kristina, exc. 5). The activities continue there, or go on to position D - the students explore their own areas of interest in whatever way they choose. The didactic plan centers on the activities of the students, leaving the teacher to observe and present a context that will inspire the students to develop on their own. The students have time to apply and create factual and procedural knowledge, but analyzing, evaluating, or meta-cognitive reflection, where the teacher is supporting the student to further understanding and generalization, are not addressed, nor is thinking made visible. The planning style is related to the maturity tradition.

The scaffolding teaching style

A small group of the observed teachers planned what was to be taught and how in ways leading to higher order thinking in class (cf. Ms. Jana exc. 2; the teacher team, exc. 6). In these classes students were given time to learn implicitly from experiences, and experiencing the same specific learning object from a variety of angles. The teacher led the students on to analysis and higher level generalization, and explicit thinking. The students were engaged in challenging and hard cognitive work, and in thinking meta-cognitively and formatively. However, challenging areas were not in itself enough to address higher order thinking (cf. excerpt 4). In fact, the ways the teachers structured and performed the activities were more important. The analytic, evaluating, and meta-cognitive questions and analysis address position B, the guided experiments and tasks address position C, the lectures A, and the exploratory and creative elements D. The integrated activities facilitated understanding of how different areas of knowledge are related. This style addressed more cognitive and knowledge targets than any of the other planning styles. It is connected to interactive theories, but this group of teachers actively used a lot of different methods, as well as thinking tools and contextual mediation to scaffold students' thinking development.

The order in which the different positions in figure 1 were addressed is important for the outcome. Starting in position C. will help the students to be motivated and relate to their own experience, B. will then make them analyze, generalize, and desire new knowledge (A), giving tools to explore on their own (D). Specific methods, e.g. thematic subject integration, don't automatically lead to cognitive effects. Depending on how they are structured, they give different cognitive results.

The 'moralistic' teaching style

Some of the lessons, or parts of lessons, faced position D, neither the product nor the process seemed planned towards a cognitive goal (cf. Ms. Jessica, exc. 7). The teacher seemed occupied with something else, presumably teaching the students how to behave, scoring no marks in the taxonomy (unless appropriate school behavior would be considered factual or procedural knowledge).

Structure, control, and intellectual challenge

In the 'moralistic' lessons the difference between the open and the hidden curriculum was big and hard to interpret, causing students to lose interest or to protest (cf. exc. 7). If the system was unclear to the students and the teacher controlled the activities, disorder and insecurity were a result, with almost no cognitive activities. Keeping the order and discipline became more important than promoting students' thinking. In many cases (cf. exc. 4) the lost interest could be explained by lack of intellectual challenge. However, in other cases students' didn't seem to mind this, if the teacher was in control and the system was visible to the students (cf. exc. 1). The more open the teacher was with

his/her expectations, the more students were able and willing to participate in and take responsibility for challenging intellectual work (cf. exc. 2, 3, 6). If students were to take intellectual risks and engage in challenging tasks, the social climate had to feel safe.

The teacher-controlled and visible system shows cognitive results, but did not train the students in thinking, creativity or in taking responsibility. The use of the common lesson structure guided the teacher to plan activities that would keep the students busy, rather than thinking. To develop students' self control and their intellectual and creative abilities the teacher had to systematically uncover the system to the students and gradually leave them more and more responsibility. This also coincided with scoring more advanced cognitive areas in the taxonomy. Work discipline was hence connected to the students' opportunity to develop deeper cognitive abilities.

Conclusions

The grey marked positions (see Table 1.) in the taxonomy were met in most of the observed classrooms. This is positive – they constitute valuable basic knowledge. Contrary to what Anderson and Krathwohl (2001) state, there are qualitative differences in the taxonomy positions, some being more advanced, at least when it comes to thinking and creative activities in the classroom. Only some teachers reached these, depending on a productive praxis theory affecting how they teach and plan activities and context.

Using the traditional, and most common, way to structure lessons doesn't promote critical thinking. Changing between the different didactic positions A, B, C, and occasionally D, in figure 1, interacting between planning either the product or the process or both, seems to promote the desired process. The students here address situations where they are to reach a specific goal, where they can explore their own goal, where the method is specified, and where they can choose their own method.

The anticipated criteria were hard to reach in most of the observed classrooms. Though most teachers showed an understanding of what would develop the students cognitively, they lacked the understanding to translate this knowledge into practice. The teachers tended to plan focusing what should be taught rather than students' cognition. Without understanding the difference, teachers seemed to accept methods and structures mechanically. This lack of understanding should probably be addressed on a practical methodical level, unveiling the micro-processes of classroom questioning and planning structure, rather than presenting more theories to teachers, if we want to change classroom practice. Anyhow, the problem has to be dealt with if students and society are to make use of school in the next century.

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