Introduction of national tests in biology, physics and chemistry and teachers' choice of teaching content

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From and including the academic year 2009/10, all pupils in Year 9 of compulsory secondary school education in Sweden are obliged to take the national test in one of the science subjects of biology, chemistry or physics. On the Swedish National Agency for Education’s website, it says that the main aims of the national test system in Sweden are to support teachers’ work in making equal and fair assessments of pupils, setting the correct grades and providing the necessary basis for analyzing the extent to which the knowledge requirements have been fulfilled at different levels. National tests can also support teachers’ work by concretizing the curricula and syllabi and increasing pupils’ target fulfillment.

Subject tests under the heading of “national tests” were introduced in the secondary school context in connection with the introduction of the Curriculum for the compulsory school system introduced 1994 (Lpo 94). Up to 2009 these tests were conducted in Swedish, English and Mathematics. Lundahl (2010, p. 223) writes that since their introduction national tests have had different purposes, but in terms of the use of the tests two main purposes stand out: to stimulate teachers’ pedagogical development and to answer questions of national interest concerning quality and equality in school. From a pedagogical perspective, questions about the different choices that teachers make in teaching- and learning situations are central. Every day teachers make choices about which content and working methods should be used and what should constitute the basis for assessment. The intention with this article is to investigate how teachers describe that national tests in natural science affects and changes the educational content, in other words, how the national tests affect the choices teachers make in their teaching.
**Centrally prepared tests and their impact on practice**

The testing of pupils has increased dramatically in recent years in Sweden – as in many other parts of the world (Broadfoot & Black 2004, Lundahl, Roman & Riis 2010). Centrally prepared tests imply a kind of control that can have consequences for both teachers and pupils. Advocates of national tests maintain that on the one hand tests contribute to a higher standard of teaching and increased knowledge among pupils (e.g. Black & Williams, 1998, Linn, 2000). On the other hand, there is a notion that centrally prepared tests can constitute a threat to pedagogical work, in the sense that work in schools are influenced by the content of a test rather than the content of the curriculum (Lundahl, 2009, p. 199). Research into the effect of tests is not clear-cut, but shows a complex picture of how centrally prepared tests influence teachers’ activities. In an overview of review articles, Cimbricz (2002) notes that there is a clear link between national tests, teachers’ ideas and teachers’ practices, but emphasizes that the relation is complex and needs to be examined. In other words, there is a need for more knowledge about teachers’ practices.

A report by the Swedish National Agency for Education (2004b) following surveys of and interviews with teachers indicates that to differing degrees teachers say that the national tests (in Swedish, English and Mathematics) influence their teaching. New teachers say that they are influenced more than those with more experience. This influence consists of the use of more specific content and allowing pupils to work with similar tasks as preparation. In the report the informants give the national tests in Swedish, English and Mathematics great legitimacy, they think that the tests reflect the national and local objectives well and contribute to clearer grading criteria and a better quality of knowledge. In another Swedish National Agency for Education report on subject tests in biology, physics and chemistry – the tests that we are going to examine – 65 per cent of the teachers said that it was easier to interpret course objectives and criteria after having worked with the national tests (Swedish National Agency for Education 2010, p. 43). In an international context there are examples where teachers, by being exposed to well-made external tests that meet curriculum goals, become more conscious about how tests can be framed and what kind of knowledge can be tested (e.g. Gilmore 2002). A case study based on interviews and classroom observations (Grant 2001) shows that centrally steered tests influence teachers’ teaching, but depending on different factors, especially teachers’ views of the subject content and learning, affects their teaching in different ways.

A common reaction to the introduction of national tests is that the teaching content is adapted to what is to be tested (Au 2007, Hamilton & Berends 2006, Orpwood 2007). Au (2007) conducted a meta-analysis of 49 American studies and found that the main effect of this type of test is that the teaching content is limited to what is to be tested, that the subject areas are fragmented into test-related pieces and that teachers increase their use of teacher-centered education. However, this picture of national tests is not clear-cut, because at the same time, Au also found that in a significant minority of the examined cases the teaching content actually expanded, that the knowledge areas were integrated and that more pupil-oriented cooperative pedagogy was used. Aus results suggest that the impact of the tests may depend on how they are designed.

Several studies on effects of national tests have taken the potentially negative effects of the tests as the starting point in their investigations (Lundahl 2009, p.168, 2010, p.228). In this article we have chosen to primarily highlight aspects that teachers acknowledges as something national tests adds in relation to science subject content. Tobiassen and Tomassen (2000) and also Boesen (2006) maintain that tests have an unexploited potential as a pedagogical tool for teachers. They write that to a large degree tests could stimulate pedagogical processes at different levels in the education system.
Educational traditions and what counts as "good" science instruction

Pedagogical content knowledge is often described as a third area of knowledge for teachers, in addition to subject knowledge and general pedagogical knowledge of schools and education (e.g., Shulman 1986). What content that should be the focus in science subjects Physics, Chemistry and Biology is admittedly stated in the curriculum for each subject, but in practice you can work with the content of the curriculum in many different ways. Subject knowledge needs to be contextualised, structured and given form and content that fits the actual teaching situation for that very group of pupils. The choice of content and teaching methods always includes certain values or criteria for 'good' teaching (Östman 1995). The choices can be described as conflicts between different options of what good science education should include and how it should be conducted. Research has shown that there are patterns in the aims and choices that have to be made in education and teaching, and that these patterns include social aspects, such as different values and approaches in society (e.g. approach to knowledge). When the choice of content and type of teaching is made in a systematic way, with obvious points of departure, we can say that the choice is made in accordance with a selective tradition (Englund 2007).

Roberts (2007) has described the battle over what constitutes good science teaching in terms of “Visions”. In principle, two different visions have been favoured in the western world with regard to how science should be framed in order for pupils to be “scientifically literate”. Roberts calls these Vision I and Vision II. In brief, in vision I it is the scientific discipline content that is to be taught. By teaching, the students learn to understand the world in terms of concepts, laws and theories that can be displayed by means of observations and experiments. In Vision I, there is a notion that the learned scientific knowledge automatically can be applied when an application is required. In Vision II this is not the case, and here it is pointed out that in addition to subject knowledge, education must also include knowledge and skills that enable pupils to apply scientific knowledge in everyday, existential, moral and political contexts. It is also pointed out that it is reasonable for pupils to be offered knowledge about the range and limitations of scientific knowledge when it comes to solving problems of this nature (see also Roth & Désautels 2002, Wickman et al., 2012).

Use of curriculum emphases is another way to categorize the content choices that are possible in science teaching (Roberts 1982, 2007). Curriculum emphases describe an epistemological content dimension that involves knowledge about scientific knowledge and purposes in scientific activity. Through analyzes of the subject content of teaching materials and policy documents in North America, Roberts (1982) found seven different curriculum emphases. Östman (1995), who has done similar analyzes in Sweden, group curriculum emphases in four educational patterns. The first pattern includes the curriculum emphasis Correct explanation, where the way to argue about why you should learn science is that scientists know what is good knowledge. This eliminates the need for education to problematize the epistemological dimension. The second pattern includes the curriculum emphases Solid foundation, in which students need to learn about logic and cumulative aspects of knowledge, Scientific skill development, where the objective is for students to learn practical skills in the scientific craft, The structure of science, that involves teaching students the intellectual skills of the scientific craftsmanship, and Self as explainer, that includes historical explanations and students' own explanations of scientific phenomena and events. The third pattern involves Everyday coping, where knowledge is justified by that you can apply them to practical issues of everyday life. Finally, the fourth pattern include the curriculum emphasis Science, technology and decisions in which education focuses aspects that have to do with applying scientific knowledge on moral or political problems.
These four educational patterns, or selective traditions Östman (1995) calls academic (positivist), academic (constructionist), applied and moral tradition.

If we consider the national tests as an educational tool, which for example Tobiassen & Tomassen (2000) argue that they could be, it would assume that the introduction of national tests can alter teachers’ perceptions of what counts as good science education and their actual teaching. We want to examine the impact of national tests for teachers’ practice.

Purpose and research questions

The purpose of this article is to examine how the introduction of national tests in science education could affect the content selection teachers express that they do in their teaching. More specifically, we investigate what content teachers talk about as new content, in relation to the instruction being pursued. The following research questions are examined:

1. What central themes can be found in the teacher's talk about the content of the national tests in science?
2. What is stressed as changes in relation to the teaching content of science education?

Method

The study that is reported here is part of a three-year project designed to examine teachers’ teaching traditions and whether teachers change their teaching practices as a consequence of the introduction of national tests in science. In the article, interviews with teachers conducted in autumn 2011 are analyzed, which means that by that time three national tests had been conducted.

Selection

The data consists of interviews with 29 teachers at 27 different schools, all of whom are involved in the teaching of physics, chemistry and/or biology in the upper years of compulsory secondary school. To allow for a variation in teachers' perceptions of teaching and assessment practices, the selection is based on that there are a number of different patterns, teaching traditions, represented in the teaching profession. These teaching traditions have been shown to be historical through studies of curricula and teaching aids (Östman 1995, see above), although it can also be shown that today teachers privilege different content in their teaching. A questionnaire survey was conducted in first part of the project (see also Lidar et al, 2012) and included questions that in different ways tried to highlight teachers’ practices in matters such as the purpose of the teaching and the choice of content and methods, as well as how the assessment of pupils was carried out. The teachers were asked to evaluate several different alternative goals, content, methods and types of assessment.

Based on how the teachers responded to the questions on the goals and content of education, a factor analysis was conducted, from which four different groups could be distinguished. The alternatives were grouped in the following factors: to teach science to impart to the pupils

A) Facts, concepts, models and relationships,
B) Preparation for future everyday life, studies and working life
C) Application of social, political, moral and existential issues.
D) Scientific modes of operation, methods and ways of thinking and reasoning.

These groups may be roughly comparable to the four educational patterns Östman (1995) demonstrated. Through the survey tool used (QuestBack / Easyresearch) we were able to contact specific respondents without uncover their identity. Teachers who ranked the responses in each factor highest were contacted about taking part in a telephone interview.

The informants in the selection have worked as teachers between two and 30 years, with a mean of 13 years. Our selection includes seven teachers according to their questionnaire responses value content in factor A highest, eight who value content of factor B highest, eleven in factor C, and finally three in factor D. In factor D, it was found that there were not so many respondents to select from because many of the teachers who valued these aspects, also valued alternatives in other factors high. In the presentation of the results we called teachers with names that have the same first letter as the factor they were selected from. The selection has therefore been made to try to find as much variety as possible in terms of how teachers talk about choices of subject matter.

Data collection and analysis

The data was collected by means of semi-structured telephone interviews lasting between 35-60 minutes. The teachers received the interview questions in advance so that they could prepare for the interviews, although during the interviews these questions were developed by means of different follow-up questions. The interviews included questions that reflected what the teachers regarded as important in science education in matters relating to knowledge objectives, content, working methods, assessment, how they planned their teaching, how they worked with assessment, both in relation to the national tests and their own expectations, what they thought about the questions in the national tests and how they thought their teaching and terms of reference had changed or would change after the introduction of national tests. All the interviews were recorded and transcribed.

Initially we identified statements about how the national tests have affected the teaching at a general level. The analysis in the article was then performed in two steps. The first step includes a thematic analysis (Braun & Clarke, 2006) where we identify themes in the teachers talk about teaching content. This means that we in repeated readings have identified passages in the interviews where teachers talk about what they see as the important content of teaching, good questions in the tests and new content in the tests, and also how they value this content. Subsequently, the passages dealing with specific subject content was compiled and thematized. The themes were designed based on the statements where teachers talk about the contents as "new" for their own teaching, which they emphasize more or differently after the tests were introduced. In the second step, the content of the themes that emerged were analyzed using curriculum emphases and visions for scientific literacy (Roberts, 1982, 2007, Östman 1995).

Results

The teachers included in the study make varying statements in relation to how the tests influence their teaching. However, a striking similarity in their statements is that in the interviews many of the
teachers say that an important function for them is that the national tests confirm that their teaching is on the right track, i.e. they feel that their teaching “fits the bill” and works. National tests are seen as a way of checking one’s own teaching against national goals. Several of the teachers expressly said that the national tests help them to concretize the content of the curriculum, both for themselves and for the pupils. In conformance with that many teachers feel that the national tests confirm their teaching, they express that the national tests provide confirmation that their earlier assessments of the pupils are reasonable, and that the national test help them to find the right level of grading (cf. Swedish National Agency for Education 2010).

Our material also naturally contains examples of aspects that the teachers regard as less good, of which the workload is the first to be mentioned, both as far as the teachers and the pupils are concerned. There are also teachers who think that national tests represent a lack of confidence in the teaching profession. They also talk about how the media can distort the image of teaching in their version of what knowledge is and how knowledge can be measured, especially when one single test is expected to correspond to the grading of work that teachers and pupils have carried out over the course of a three or four year period.

In Au’s (2007) meta-study of the influence of national tests in the USA, it was shown that in the majority of cases the teaching content was limited and divided up into test-related parts. The teachers in our study said that they felt pressured to cover everything. Some teachers indicated that their teaching had to be wide-ranging, because nobody knew which tests the school would get and which areas the tests would cover. The consequences of this for the teaching can naturally take different forms. One consequence of a wide-ranging content could be a reduction in scope for more advanced work. The question can also be linked to how the teachers saw that their room for manoeuvre and independent choice in the teaching was affected. Here several teachers said that they thought that they could more or less teach as they always had done, while others felt more restrained. As in a previous report on the national test system in Sweden (Swedish National Agency for Education 2004a), some teachers said that their room for manoeuvre was reduced, although at the same time they regarded this limitation as positive, and as a support for how the teaching ought to be conducted.

Our selection of informants is based on findings that all teachers do not value the same content issues as high in their teaching (Lidar et al., 2012, Lundqvist et al., 2012). At the same time, we can see that teachers from all four selection factors perceive that their teaching correspond well with what is measured in the national tests. However, it is not the content that is confirmed that is the focus of this study, but rather the content that is described as new, where changes in the teaching is described as needed. Henceforth we will introduce variations in the contents described as new in the teachers’ statements.

**Change of content**

Three main areas or themes are highlighted as good content or content that has not been worked with very much in the past, where the national tests have led to teachers focusing a new content in their teaching. These areas are about scientific argumentation, the history of science and laboratory work.

**Scientific argumentation**

This content is formulated in a few different ways in the tests. One type of questions are either based on a number of arguments that are expressed by four different people ("Concept Cartoons"), or are presented as a number of statements or arguments. The arguments are constructed on the basis of real,
everyday dilemmas. In the exercises the pupils are expected to choose the alternative or alternatives that are based on science. Some of the exercises also describe how a person or organization can make use of the argument. Among the available alternatives some of the answers are correct, but as they do not use arguments from natural science they therefore do not offer the right kind of evidence for a correct answer.

Teachers give several reasons for why they emphasize these exercises. Some say that it is difficult to invent exercises that measure knowledge of this kind on their own, and that this kind of knowledge is difficult to assess. The national tests show a way of doing this, and some teachers say that they try to create similar exercises. Some teachers also say that it is the scientific content that is important for pupils: “the majority of my pupils get embroiled in economic arguments and I have a real problem in getting them to use scientific arguments” (Beata). Science helps us to differentiate between opinion and what can be proved, “so that you don’t just believe anything” (Benita) as one teacher says.

Several of the teachers use this approach, but of one of the teachers deepen the argumentation by emphasizing the difference between the individual positions or opinions in ethical discussions and scientific evidence:

Then you get precisely this, that what is science, what can be proved, how you distinguish between thought and reality, or what is demonstrable. There are so many people just reckon things. It's like, you have to get a deeper understanding, one must be able to analyze ones responses as well, why is it like this, why, this is always useful. This that many people just reckon things is arbitrary and individual, we do so to create relationships with each other, but when it comes down to getting to a solution, you look at science to solve the problem, then you cannot reckon, but then I have to prove and that's what I want to train them to do. In reckoning, ethical debates, there one can always have whatever opinions they want really (Dennis)

These exercises commonly use topics that deal with environmental issues, sales arguments and lifestyle issues. Some teachers speak of this content as difficult to teach and here the tests show examples of how exercises can be formulated.

Several teachers in the selection mention the questions dealing with scientific argumentation as exemplary of tasks, but not all teachers agree. There are also teachers who think that the level of these exercises is too low and that the answers are obvious:

D: [...] yes you should on tests like this so which one of these is a scientific argument, it's just nonsense they want, the only one. One does not, the pupils can read and make it out directly, there is no doubt. It's become even more apparent in the goals, it's an important part.

I: To be able to argue?

D: Recognizing an argument that is not based on scientific grounds. They should know this, but the questions asked on national tests are at a low level, I think. Yes, it is no problem for my pupils at least what I perceive (David)

On the theme of scientific argumentation teachers also mention tasks where it is not about to sort out which arguments are scientific, but also tasks where pupils are expected to figure out two ways of arguing that are both scientific. The task is typically to describe these different ways of arguing. In this task it is shown that people valuate scientific information in different ways and different decisions could be made starting from the same scientific knowledge. One teacher mentions this type of task to be exemplary educational content and think it is a good task because "it had like everything"
(Claudia). She mentions topic the question is about, the impact on the environment and how it contributes to make the pupils think about that people make different decisions. Another teacher talks about another task of the same type as a good exercise because "it's a hot topic and they got to see an issue from two different angles" (Carin).

**The history of science**

The history of science is something that several teachers say that they have hitherto ignored in their teaching and that they have focused more on now as a result of the tests. These exercises concern important discoveries for mankind, and here pupils are expected to describe the use that humans have had and have of the discovery and how it has affected their view of the world at large. The teachers say that this type of exercise is good because it helps the pupils to understand the value of science for human development and is good because it makes the pupils think for themselves. They also think that the history of science helps to put knowledge into a proper context, stimulates pupils’ interest in science, and encourages them to want to know more.

Knowledge about history of science is also considered to help the pupils finding out that it is not enough just to learn facts, the pupils need to be able to explain how knowledge about a discovery has developed:

> Because if you know everything in the book, if you know your facts, if you know this about [X], or that about [Y] but then you also have to think about, well if that didn’t exist, how would it be then? That kind of questions are more okay to write now, it was kind of strange 10 years ago. The pupils weren’t at all used to these kind of questions about how do you think it would have been, and both we and them have got used to that you also have to think by yourself (Cajsa)

The teachers include this content in their teaching to a greater extent and in a different way than before and see it as a content that will benefit the pupils.

> What I think has been exciting about the national tests is how to think about the history and the world around us, it’s for the higher grades in the tests and I have tried to add it to the everyday teaching and to get them to talk about what it looked like before and what would have happened if it wasn’t for this discovery, how could that have affected us (Benita)

In the teachers’ utterances about this kind of content they emphasize that the history of science is a neglected but important content because it can help the pupils to pay attention to scientific knowledge and its growth and how this kind of knowledge has contributed to and influenced community development and conditions for human beings today.

**Laboratory work**

The laboratory work in the national tests is a separate sub-test, and is part of the test that many of the teachers regard as something they think differently about after having conducted the national tests. What is different in relation to the usual way of working is not so much the content, but how the experiments are performed. In the laboratory test the pupil is first of all expected to draw up a plan for the experiment. This plan is assessed by a teacher, and if it is approved the pupil continues with his or her own planning. If it is not approved, the pupil is given a prepared plan, after which he or she conducts and evaluates the experiment. Allowing pupils to draw up their own plans for the experiment represents a new way of thinking for many teachers.
One teacher says:

What was different when we received the national tests was that you try to give the pupils questions, open questions. [...] They have to try to find their own experiments with hypotheses and so on. I’ve learned that from the national tests, instead of just providing ready-made instructions from which they might achieve something without understanding what or why. Starting with a question and working out how to tackle it is an amazingly big thing and awakens the pupils’ research instincts (Carl).

I can say that I have done experiments without really knowing why we’ve done them. If anyone had asked me why we had done such and such an experiment I would probably have said, well, we’ve always done that. But now I’ve begun to be a bit more calibrated about what I do (Carl).

The teacher quoted above has reassessed what the aim of laboratory work is about and it has changed his teaching. This change is about learning new ways of dealing with a particular aspect, in this case what can be regarded as the purpose of conducting an experiment. The returns that can result from this way of working also mean a change for the pupils, who have an opportunity to work in a more research-like way.

Another teacher expresses that she has had thoughts about how laboratory work in school usually is conducted and that the national tests has brought another way of looking at it:

I haven’t worked that long as a teacher but in some way you have had the idea that the pupils should follow an instruction and do this and write a conclusion, but in the national test it is totally different. They are supposed to formulate and prepare an investigation and I have started to work like that. You conduct fewer investigations, but you do it more thoroughly in a certain area, they are supposed to prepare, perform and then evaluate. Both evaluate and see if they can do it in a better way, so I really think this has influenced (Clara)

From the teachers’ descriptions we can gather that, in the past, laboratory experimentation was much more about working with the laboratory equipment and being able to follow specific instructions than understanding and using scientific ways of thinking. The laboratory part of the test has meant that teachers have acknowledged a new way of thinking about what experiments are and can contribute to the work. Laboratory experiments are also talked about as characteristic of science teaching and that it is good that they have been highlighted in this way, because experiments are specific to the subject and makes it different. This new way of working is described positive by most of the teachers, but the implementation takes time:

We have started on having more open experiments. I work a lot with them, but still it is the instruction that tells how to proceed. To have the pupils make plans out for themselves, I haven’t worked at all with the pupils planning their own experiment, but I realise that this will steer my teaching now that I know how the national tests are made. You will need to start with these kinds of laboratory experiments already in the 6th grade and upwards, you can’t start with it some weeks before the test (Disa)

But there are also difficulties with this kind of set-up, because of the design is not in the ordinary range of tasks that are available:

I would really like to work in this way, and I would really like to create experiments but that takes up a lot of time, and so far I haven’t been able to find any ready-made ones (Camilla).
This teacher expresses that open experiments are the ideal that she would happily work with if the material was available in textbooks or experiment banks. Open experiments mean that the teaching situation becomes more complex, because all the pupils in a teaching group may not be able to choose to investigate a certain problem in the same way. It also means that teachers must have the wherewithal to deal with all the suggestions a pupil comes up with, and that this could be something that leads to teachers becoming uncertain in their role.

Although the majority of the teachers are positive to laboratory experimentation, some wonder what laboratory work actually contributes to:

I think that the level of laboratory experiments has been quite low. But given the prerequisites with materials and so on, we haven’t been able to do much more (Anna).

This is also a teacher who considers that open experiments are an important way of working and a distinctive trait in her teaching. If her pupils have practised doing similar exercises to those in the national test, it could contribute to the seeming low level of difficulty.

**Concluding analysis**

We have found three themes that teachers talk about as something new, contributing to their choice of teaching content; tasks about scientific argumentation, tasks about the history of science and laboratory work.

In a summary of the content within the theme of scientific argumentation, we can see that the theme includes two fundamentally different contents. There are common features of the different argumentation themes when it comes to familiarize oneself with the scientific process of thought and the way to deal with the relationship between theory and evidence. What sets them apart is that in the first way of dealing with argumentation the pupils are supposed to distinguish what is science among all kinds of information, since science can provide solutions to various problems in the world. The content that characterizes these tasks can be described in terms of the curriculum emphasis that Roberts (1982) calls The Structure of science emphasis. Central in teaching within this emphasis is the importance of having the pupils developing a critical capability that gives provides them with the opportunity to assess the reliability and validity of scientific investigations. In the other way of reasoning about argumentation, the teachers addressed a valuation aspect, where scientific arguments, but also other arguments, can be used to make decisions and find solutions to problems and dilemmas. Content characterized by valuation is central within the curriculum emphasis Science, technology and decisions. Within this emphasis it is stressed that there is not only one correct solution to a problem, you have to evaluate different alternatives. This makes decisions take a political, moral or existential character.

The difference between the two distinguished parts of argumentation content could also be described in terms of Vision I and II. The first variant is about The Structure of science emphasis, in Roberts (2011) vision I, while the second argumentation content is about Science, technology and decisions, with a contextualization that allows it be placed in Vision II. A task where the content is focused on The Structure of science emphasis, focuses on knowledge within science itself, ie. pupils are expected to solve the problem using the knowledge and ways of reasoning that are valid within science. A task with the same content, but developed within a Vision II context, however, contain not only the
knowledge within science, but start in a context of political or moral character and make use of scientific knowledge to solve the problem (Roberts 2011).

In the exercises about the history of science teachers stress that it is an important content to understand how scientific knowledge developed and to describe the importance it has and has had for our world and its development. Also this content is related to The Structure of science emphasis, as it deals with how scientific ways of reasoning has evolved and the significance of scientific explanations. It would be convenient to think of the curriculum emphasis Self as explainer, would be as made visible here. The teachers’ statements, though, are not about the pupils using the historical models for explanation in their own thinking or in their own understanding of scientific phenomena, but rather to use scientific ways of reasoning to understand why the world looks the way it does. That said, we see that it is the curriculum Structure of science that is stressed in teachers’ talk about this content.

The laboratory work is the part of the tests that in the teachers' responses most clearly seems to develop the content selection the teachers make. Laboratory work is a content that according to many teachers characterize the nature of scientific activity. The laboratory tasks from the national tests have demonstrated a new content in instruction, for pupils to plan their own investigation, which is something that few teachers have worked with before. This part of the lab focuses on the critical selection of different procedures and on considering the probable results of the prospective study and not on the practical work in implementation of the lab. When experiments are used to assess the reliability and validity of the scientific results, a way of asserting knowledge that expresses the curriculum emphasis The structure of science is used (Östman 1995). The practical craftsmanship in laboratory work and evaluation of the results, is something that the teachers have included in their teaching to a greater extent before. The practical craftsmanship of science is included in the curriculum emphasis Scientific skill development and is also a goal in the lab part in the test, since the pupils should practically implement their planned lab. This kind of knowledge though, is not included in the teachers’ talk about the laboratory part in the tests. Rather it is the planning, that is, the scientific intellectual process, which is stressed as a new content in the laboratory task.

What seems to unite these three content areas are the intellectual dimension of scientific knowledge, ie. The structure of science. The content that is particularly central within The structure of science emphasis is the way of thinking in the research process and the way of dealing with the relationship between theory and evidence. Wickman & Persson (2008 p. 208) write that when the scientific content taught in this way, the purpose is to give pupils opportunities to assess and evaluate scientific claims and create a critical stance. A possible explanation for this is that The structure of science is a content that many teachers recognize as a key content in scientific activities, and as something that is characteristic of how to work in science, but a content that teachers did not have the tools to teach about. In the national tests they find the help that makes them feel comfortable with, teachers get aware of the content and how it can be taught so that they can apply it in their own teaching.

**Discussion**

In this article we have examined how the introduction of national tests in science education has affected the content selection teachers express that they do in their teaching. This has meant that we have studied what content teachers talk about as new content in relation to their teaching. The interest is based in one of the objectives of the tests, to stimulate teachers’ pedagogical development. We could identify three themes that teachers talk about as new content in the tests; scientific argumentation, the
history of science and laboratory work. With this result we claim that in the national tests in science education, as they were designed in 2009-2011, there is potential for stimulating pedagogical processes, concerning science education content that focuses on The structure of science. A few of the teachers have also noticed content in the tests related to the curriculum emphasis Science, technology and decisions. Roberts (2007) has shown that in terms of tests and evaluations it seems to be knowledge that vision I advocate that tends to be tested (cf. also Orpwood 2007). There is content in these tests that the teachers talk about that enables them to take in valuation aspects in their teaching. In the empirical material there are two teachers recognizing this content, both selected from the group where applications of social, political, moral and existential issues are stressed.

Jakobsson et al. (2013) have analysed a trend that points to that Swedish pupils perform worse at the science part of the international PISA test. The study seeks to nuance what trend consists of. The results show that Swedish pupils perform as well, or even better than before, on tasks requiring factual knowledge. The decline can be found foremost on tasks with a content that is attributed by The Structure of science emphasis. If this is the content we think should be rewarded in science education, the results from both the present study and Jakobsson et als. study, would implicate that Swedish teachers need to work even more to include this type of content in their teaching.

In the interviews with the teachers, we note that there are variations in what they interpret as important content in the tests. The results also show that teachers from all sample groups describe that the content in the tests corresponds well to the teaching that they undertake. They also express that they receive confirmation that their teaching is at an appropriate level and that they have made a reasonable selection of educational content. There may be various reasons for this result. For example, it may be due to that the tests are so multifaceted that all teachers can find different content that they feel is consistent with how they view science and how they teach. There may also be an explanation that teachers primarily perceive the content of the tests that match how they view science. This compares for example with Fensham & Corrigan (1995), who describes how teachers' approach to teaching and learning is relevant to how a reform falls out. Teachers who before the launching of an educational reform were influenced by a constructivist approach to teaching found it easier to make positive interpretations of the changes that were introduced. In general, others had not realised the intentions of the reform, but had instead regarded it as a re-organisation of the traditional subject content.

The impact of an educational reform on educational activities may show as changes in different segments, personal, internal and external (Goodson 2003, p. 87). The personal part of a process of change involves the teacher subject knowledge, teaching methods and how teachers view their professional role. Educational change is according to Goodson most successful when the change relates to a personal segment. In this study, we have chosen to focus only on issues that have to do with the personal segment. That the teachers find that their choice of content is confirmed could mean that they do not need to change their teaching to any great extent. However, we should bear in mind that change does not automatically follow on from the implementation of a new steering function. Goodson writes that:

A good deal of the negotiation of change involves confronting existing memories of schools and school practices. These memories of what constitute ‘school’, ‘subject’, or ‘teaching’ do not just reside in internal agents’ minds, but are also crucially and historically embedded in the wider community. (Goodson 2003, p. 99)

With this in mind it is important to pay attention to the selective traditions or educational patterns that Östman (1995) describe in relation to changes in teachers’ teaching. Further analyses of the interviews
with these teachers can show whether or not the changes in the teachers’ practices as a consequence of the implementation of national tests, are consistent or if the changes are also depending on which educational tradition the teacher is practicing.

References


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Since the tests are confidential, all references to subject areas in the tests are removed.