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Introduction

“We know exactly what biology is. We can draw the boundary lines [. . .].”

Tore Donner, ABT (Board minutes, May 23-24, 1970).

Following the rapid acquisition of new knowledge in the sciences in the mid-20th century, science education tried to adapt. At the same time, political impetus to change and improve science teaching in secondary schools, particularly after the so-called Sputnik shock in 1957, resulted in the 1960s in projects such as the Biological Sciences Curriculum Study (BSCS) and the Physical Science Study Committee (PSSC) in the United States and Nuffield in the UK that involved both teachers, scientists and politicians (e.g. Rudolph, 2002). Actors that have often been either invisible or underestimated in the history of science education are the *subject associations*, which include subject teachers devoted to advancing their subjects in schools and in teacher education.¹ They originated primarily in Great Britain around the turn of the century in 1900 but were soon formed in other countries around the globe, and played a major role in promoting science education both as interpreters and defenders. They constituted a link between school science, the universities and the political arena, at least in Europe and New Zealand where most of the historical research on these associations was done (Goodson, 2005; Jenkins, 1998; Knight, 1996; Layton, 1984, 1988; Lindholm, 1991;

¹ Subject associations (or subject teaching associations) focused mostly on the subject matter and teaching in single subjects. They should therefore not be confused with teachers' unions, which concerned themselves primarily with teachers' jobs, salaries and working conditions.

McCulloch, 1992). Subject associations in other parts of the world, for example, the USA, have hardly been the subject of historical inquiry at all (Rudolph, 2005 being an exception).

Using a concept from Thomas F. Gieryn, *boundary-work* (Gieryn, 1983, 1999; Hays Lynning, 2007; Rudolph, 2003), it is possible to pinpoint the essence of the work of subject associations in relation to their subjects – constructing and defending boundaries around the subject domain, in schools as well as in teacher education and academia (cf. Shapin, 1992). Boundary-work, according to Gieryn, offers a sociological explanation for the cultural or epistemic authority of one image of science over another, and as such it is a kind of *cultural cartography* that results in *cultural maps* of school biology and biology in teacher education. However, boundary-work is also “a [. . .] stylistic resource for ideologists of a profession or occupation”, when the goal is monopolization or expansion of its authority and expertise or protection of its autonomy (Gieryn, 1983, pp. 791-792).

In all its complexity, therefore, boundary-work in this study concerns how subject teachers through their associations demarcate, protect and expand the boundaries of the cultural map of biology in teacher education. This is a precarious balancing act between the interests of the school and its subject teachers, teacher education and academia, as well as politicians wanting to exert political influence. What may at least superficially seem like merely defending certain biological items instead of others, in the name of science, may therefore also be a professional struggle to assert the importance of the teachers, their jobs, education, knowledge of biology subject matter, and thereby their professional authority and autonomy (Gieryn, 1983, 1999).

Biology has a long tradition in Swedish schools, first as part of elementary school science since the mid-19th century and then in secondary education as a separate subject from the early 20th century onward (Hultén, 2008; Kaiserfeld, 1999; Lövheim, 2006). The Swedish Association of Biology Teachers (ABT) has been a central defender of biology as a subject in Swedish secondary education and teacher education ever since the forming of the association. Initiative was taken in the spring of 1933 to form the ABT, after a reduction of biology education in a new secondary school curriculum, and the association soon embraced some 250 members. According to the statutes the ABT should “work for the promotion of biology teaching and for the improvement of its working conditions . . . as well as for the strengthening of the position of the biological sciences in Swedish cultural life” (Minutes of constituting meeting, June 5, 1933). In 1965 the ABT comprised 85% of Sweden’s secondary biology teachers, but this percentage has declined since then.

Swedish biology teacher education, which was divided for very long into the disciplines of zoology and botany, was supplemented in the post-war years with a small course in hygiene, which the ABT had been instrumental in creating (Linnell, 1973; Näsmark, 1975). The challenge for the association from the 1960s onward was to make the universities adapt to a school subject which integrated several biological sciences as well as, for example, sex education, and alcohol and narcotics education under the umbrella “biology” (Hultgren, 1967). The activities of the association can be understood as boundary-work since the ABT defended and expanded the subject’s boundaries in terms of content, study time, and legitimacy, both in the school and teacher education (Gieryn, 1983).

Teacher education on a global level was in transition in the post-war era and the development in Sweden reflects some of the dominating trends, for example, the world-wide changes in secondary education. Gaining impetus after World War II was a movement away from elitist, multi-tracked secondary schools toward less differentiated, more comprehensive forms of secondary education (Kamens & Benavot, 2006), which also resulted in revisions of science teacher education. Following 20 years of preparation, the Swedish elitist parallel school system in 1960-65 gave way to democratic, egalitarian education for all. The unitary compulsory school that provided both primary and lower secondary education (7-16 years) was formed. A reform of Swedish teacher education was initiated in 1960 to reflect the coming new type of school. When it was finished years later it became known as the 1968 Teacher Education Reform, whose aim was to bring closer together the formerly separate primary and secondary teachers.

Another trend in teacher education was the bridging of the gap between subject matter and pedagogy, universities and teachers’ colleges, which proved difficult in many countries, regardless of school system (Mirel, 2011; O’Donoghue & Whitehead, 2008). Indeed, it can be considered the most complicated controversy in teacher education across the globe. As Openshaw and Ball argue about the New Zealand case: “The root cause of this historical ambiguity lie in the two conflicting models of teacher education that have historically jostled for supremacy. One sees teaching as a practical craft centered on classroom management. The other accepts the need for these skills, but also sees teaching as a learned profession [. . .]” (Openshaw & Ball, 2008, pp. 155-156). In the 1970s and early 1980s there were ambitions in Sweden to make teacher education more coherent, which led to the 1988 Teacher Education Reform for compulsory school.

Neither subject associations nor their role in teacher education have been very common in research on the history of science education (e.g. Crook, 2012). The aim of this article,

therefore, is to describe and analyse how the ABT and some other subject associations helped form pre-service biology teacher education in two major Swedish reforms from ca. 1960 to 1990. In these reforms, various cultural maps of biology as a teacher education (and school) subject for secondary education were promoted and negotiated (Shapin, 1992), but this study particularly concerns the point of view of the subject associations, notably the ABT.

The source material utilized in this study includes, first of all, minutes of the ABT executive committee, board and annual meeting, the ABT annual reports, official statements and various letters, both from the Swedish National Archives (*Riksarkivet*) and the ABT's own collection. Secondly, there is the ABT journal – *Medlemsblad för Biologilärarnas förening (MB)* for 1960-1964 and *Biologen* for 1965 and onward.² Thirdly, various curricula as well as parliamentary documents such as official reports (SOU) and bills (Prop.) have also been used. The method employed is a hermeneutic one, that is, a method of text interpretation. Single texts are related to the whole body of texts, the genres, and historical context in a reciprocal, re-interpretive way. The stance put forward here is historicist, that is, meaning is determined by the context in which the source material was written as well as the historian's own context (Burke, 1992; MacLean, 1986).

Organization and governance of the Swedish school and teacher education

The governance of the Swedish public school system is quite unique from an international point of view, since the Government's political and non-political administration are organized separately. The Ministry of Education is the central political body. The Minister appoints commissions, receives statements in response to the commissions' proposals and also presents bills. The *Riksdag* (Parliament) is the highest decision-making body, but every resolution is prepared and in practice decided in advance by the special school committee (*särskilda skolutskottet*). The National Board of Education (*Skolöverstyrelsen*, nowadays *Skolverket*), formed in 1920, is the non-political central administration, which executes and follows up reforms, supervises teacher pre-service and in-service education, and funds pedagogical research, etc. (Marklund, 1983, 1989; Richardson, 1999).

Prior to the 1962 compulsory school reform, Swedish schools were separated into several different, partly parallel educational forms. The basic distinction was between elementary/primary education – *folkskola*, a locally organized seven- to nine-year type of

² As with other subject associations, for example, the Association for Science Education in England and Wales (e.g. Jenkins, 1998), there were conflicts within the ABT regarding policy, curricular changes and other things, but in this study I primarily focus on the official opinions and statements of the association as a whole in relation to other external actors and subjects.

school for the children of workers, farmers and the lower middle class – and secondary education – *läroverk*, which was a type of school for middle and upper class boys, organized by the Government. Since girls were not allowed in secondary schools until 1927 private girls' schools constituted yet another form of secondary education. The 1962 reform meant the introduction of a unitary, obligatory school form for children of both sexes and of all social classes – *grundskola*, a nine-year compulsory type of school (ages 7-16). In 1964 came a reform of the upper secondary level – the voluntary *gymnasium* (ages 16-19). Lower secondary level (ages 13-16) had then already merged with the new compulsory type of school (Hartman, 2005; Richardson, 1999).

Swedish teacher education was adapted to the structure of the school system. Until the 1960s, there were essentially two kinds of teacher education for the public school system. Prospective elementary school teachers went to teachers' colleges (*seminarier*) in which progressive ideals and child-centred instructional methods dominated and subject knowledge took a back seat. Pre-service secondary school teachers, the focus of this article, first went to university where they acquired subject knowledge, and then took a one-year teaching practice session at a secondary school – *provåret* (Hartman, 2005; Linné, 1996; Sjöberg, 2006).

The ABT and biology teacher education for a new unitary school in the 1960s

When the school system and teacher education were being reformed in the early 1960s, many members of the ABT wanted to renew and improve biology teacher education by adding courses, primarily in human biology (medicine) but also, for instance, in ethology. Human biology was a bone of contention as it reflected an old tension between the school subject and biology teacher education; it was the single most debated teacher education issue within the association in the first half of the 1960s. At the same time a voluntary summer course in human biology set up at Göteborg University by a member of the ABT was very popular among the members, so there was already work within the association to alleviate this discrepancy between the school and academia. If biology teachers saw a need to update and expand their knowledge in an area not sufficiently covered by teacher education, they apparently took advantage of whatever form of in-service education was available (Linnell, 1973; Lüning, 1961; Näsmark, 1960, 1961, 1962).

At this time there was an immense expansion of the biological sciences, a sign of which were a number of Nobel prizes in the post-war years (Bowler, 1992; Uddenberg, 2005). This development affected biology teaching in Swedish schools, especially the new curriculum of

the upper secondary school (Lgy 65) which focused on laboratory-based sub-disciplines such as biochemistry, molecular biology and cell physiology. This led to a greatly enhanced need for in-service education, especially for older biology teachers educated mainly in botany and zoology (Svanfeldt, 1969). However, it also created further tensions between the school subject and teacher education, making a reform of the latter urgent.

A big teacher education investigation – the LUS, which was short for *1960 års lärarutbildningssakkunniga* – was carried out by a teacher education expert group established in 1960. It was appointed by the Government when it realised that the school reforms would also influence the way teachers were educated. When the bills about the new compulsory school and the new upper secondary school were passed in 1961 and 1963 respectively, the expert group was thus given more precise directives. The focus was on integration, not only between different teacher categories – elementary and secondary teachers – but also between pedagogy and school education on the one hand, and academic traditions and subject matter on the other. The directives thus reflected dilemmas permeating teacher education not only in Sweden but also in many other countries (O'Donoghue & Whitehead, 2008). LUS published some official reports but it was in particular the main report – *Lärarutbildningen* (SOU 1965:29) – that the ABT commented on when it was finished in 1965 (Marklund, 1989).

For the ABT and other subject associations the LUS investigation was promising. LUS was commissioned to resolve the aforementioned tension, namely, the classical problem of congruence between school subjects and the subjects in teacher education, which corresponded to one or several academic disciplines. There were two dominant views of what should take precedence. On the one hand there was a “scientific” view which dictated that the content and methods of the academic discipline decide how one should draw the boundaries of school subjects and thereby teacher education. On the other hand there was a more “progressive” view which took society and the school as a starting point for how the school subject and teacher education should be defined and delimited. The solution to the dilemma of congruity was, according to the LUS, a more pragmatic and flexible approach to teacher education both from the standpoint of the school and academia. The LUS report thus proposed a fixed yet elastic combinatory system of smaller courses (SOU 1965:29 p. 204-215).

LUS proposed that pre-service teachers should follow a three-year (lower secondary) or four-year (upper secondary) program at university to study the subject matter, and a one-year session at a special teachers' college, *lärarhögskola*. The various subjects were to be taught in fixed combinations with a given number of other subjects. Unlike in countries such as the

USA, where there was a multitude of subject combinations that science teachers were teaching (W. V. Mayer, 1986), the new unitary Swedish school system required predetermined combinations. A basic biology education, according to LUS, was thus made up of at least one semester each of zoology and botany for lower secondary level, and one more semester of either of them for upper secondary. Apart from this, courses in hygiene and genetics were required. Biology would mainly be combined with chemistry, which, in turn, could be combined with mathematics or geography at the lower secondary level. At the upper secondary level, there were also courses in biochemistry and earth sciences, lasting about one semester, as a requirement (SOU 1965:29 p. 352-371).

Because, historically, it had been a major problem for biology education, the ABT commented on the congruence problem in an official statement in response to the LUS report. The association wanted to "express satisfaction with the judgment of the experts regarding the need for teacher education which is designed directly for school teaching and finds that the proposals of such education have solved the problems of integration and congruence well" (RA, BF E1:7, Official statement of the ABT to the Ministry of Education regarding the LUS report, October 31 1965, p. 1).³ However, the ABT was not content with the length of biology teacher education, questioning the fact "that such a comprehensive and multi-faceted subject as biology" had to be taught within the same time frame as all other school subjects (Official statement of the ABT regarding the LUS report, 1965, p. 2). The ABT reluctantly accepted the proposal, however, as they realized that one particular subject could not alone gain such a privileged position compared to all the others (Official statement of the ABT regarding the LUS report, 1965, p. 3-4).

The ABT was also critical of the compulsory combination with chemistry in secondary school. It was believed that this particular connection to chemistry would scare away many teacher students from reading biology:⁴ "Although their main interest is biology their talent may be somewhat inclined toward the humanities. Biology is certainly largely a complex of natural sciences but it also contains elements that gravitate toward the humanities" (Official statement of the ABT regarding the LUS report, 1965, p. 3; "Remissvar på LUS-betänkande," 1965 p. 96). In line with this the ABT suggested there should be more humanities and social science items in biology teacher education, as well as a new interdisciplinary combination in the school:

³ All translation from Swedish into English was carried out by the author.

⁴ See also (Henrysson, 1965; "Remissvar på LUS-betänkande," 1965 p. 96). Due to the emphasis on organic chemistry and biochemistry in the new upper secondary school biology there were demands from the ABT for more chemistry *within* biology teacher education, however.

Social science gradually includes more and more items that rest on a natural science, primarily a biological, foundation. *Biology in the service of society* is therefore proposed as a new element of biology teacher education. The significance of public health and nature conservation for the creation and maintenance of a decent environment for humans is becoming clearer and clearer. In actual fact this is an increasingly important human-oriented branch of the biological science *ecology*, the interaction between living plants and animals and their surroundings. The [ABT] Board is of the view that these facts strongly justify the establishing of a combination of *biology and social science* [. . .] (Official statement of the ABT regarding the LUS report, 1965, p. 3).

In connection with the reform of upper secondary education a year or so earlier the ABT was worried that social science teachers would not be competent enough to teach the supposedly traditional biological domains of nature conservation and water protection, which had become part of the social science curriculum (RA, BF E1:7, Official statement of the ABT to the Ministry of Education regarding the proposal of the *Gymnasieutredning* (GU), February 15, 1964). The statement concerning the LUS report constituted boundary-work that would remedy this problem. The proposed interdisciplinary teacher would thus "be able to give the pupils a [. . .] very valuable integrated view of society in relation to living nature" (Official statement of the ABT regarding the LUS report, 1965, p. 4).

Integration was not always a good thing, however. The ABT was critical of the LUS integration of pedagogy and subject teaching methods (*ämnesmetodik*) in teacher education. Instead the association wanted to substantially increase subject teaching methods at the expense of pedagogy, which they thought was too general and theoretical. In particular, it was considered pivotal for the teacher students in biology to be able to see experienced teachers in action in the classroom, since the subject involved so many laboratory and experimental elements. It is notable that the ABT approved of a "far-reaching integration between different biological disciplines" as well as disciplines it thought biology had something in common with or something to gain from, such as social science, but not pedagogy, which was considered outside the disciplinary boundaries of biological subject matter (Official statement of the ABT regarding the LUS report, 1965, p. 5-6).

The ABT comments on the LUS version of biology teacher education are very interesting in view of the above discussion of congruity. Perhaps the most important issue concerned human biology or medicine, which had been largely missing in biology teacher education prior to this. The ABT, however, seemed largely content with the proposed biology subject

matter in this regard, especially the fact that it was to be taught by medical faculty members. On the other hand, certain other items of the proposed biology teacher education were criticized as either poor or entirely inadequate, such as sex instruction and alcohol and drug education. The gap between teacher education and the school subject had thus not been completely bridged when it came to human biology (Official statement of the ABT regarding the LUS report, 1965, p. 6-7).

The reform of teacher education was complex since it involved the universities but was also dependent upon the new secondary education. The reform was meant to integrate the former elementary teacher education and the system of one-year teaching practice for the secondary teachers. This proved very difficult, however, despite the fact that both these two teacher categories now worked in the same integrated compulsory schools (Marklund, 1989). The old tradition of different teachers for primary and secondary education proved difficult to change; for example, many old elementary teachers' colleges (*folkskoleseminarier*) were successful in lobbying for their continued existence. The 1967 Government Bill therefore became a compromise which cemented the gap between primary and secondary teachers. This did not affect biology, however, since the main components of the proposed secondary biology teacher education were realized (Prop. 1967:4).

The specific details of the various subjects in the new teacher education were taken care of by a large University Chancellor investigation. It concerned university education and which subjects could be combined for a university diploma (Prop 1967:4 p. 1-3). The appointed committee with the nickname UKAS suggested a more controlled and structured university education. In biology teacher education, for example, chemistry should be the main combination. Biology and chemistry were thus to be studied for one academic year each in order for the student eventually to achieve a bachelor's degree (Berg, 1968). The public reaction to the UKAS proposal was overwhelming, not least from university students who thought that this was a way for the Government to impose greater control on the universities and thereby the students' free choice of education. Therefore, in 1968, the year of great unrest and student revolts all over Europe, this became yet another argument for protests on the part of students, particularly at Stockholm University. One of their own buildings, the so-called *kårhuset*, was occupied, which forced the minister of education Olof Palme to withdraw the proposal (*Högre utbildning och forskning 1945–2005 – en översikt*, 2006).

The ABT also protested, albeit in only words. The association was of the view that the UKAS proposal contained a completely insufficient amount of biology. The main problem was the possibility of becoming a biology teacher even in upper secondary schools after

having taken only two semesters of biology, thus circumventing the teacher program which required one and a half academic years. This was by no means unusual from an international point of view; a teacher certificate could be obtained in various ways (Openshaw & Ball, 2008; Zeichner, 2008). According to the ABT, however, biology was a complex knowledge domain of high societal relevance. Due to its scope it was regarded as a "double subject", similarly to, for instance, social science which included political science, cultural geography and economics, and Swedish which included language and literature. The ABT therefore demanded at least one and a half academic years of biology for pre-service teacher students who would teach in secondary education ("BUKAS," 1968; Donnér, 1969; Fred, 1968; Nyqvist, 1968 p. 5-6). In 1969 Olof Palme carried out a revision of UKAS – changing the name to PUKAS, where the P stands for Palme – which did not lead to any improvements for biology teacher students from the point of view of the ABT. Even with this, biology teacher education for upper secondary school comprised only one full academic year (Hultgren, 1969).

The ABT, subject associations and the advent of progressive teacher education in the 1970s and 1980s

In the early 1970s it became clear to different actors, not least the National Board of Education, that the 1968 Teacher Education Reform had failed in producing teachers for a type of unitary school for all; the division between primary and secondary teachers remained, in the schools as well as in teacher education. In 1974, therefore, a new teacher education committee – *Lärarytbildningsutredningen*, LUT 74 – was appointed (SOU 1978:86).

Although very little detail was known, in the fall of 1977 some central ideas of the LUT committee's proposal became known to the ABT, and Börje Strömberg commented on them in the journal *Biologen*. Strömberg began by expressing what many members probably felt at the time: "For us within the ABT [. . .] what has leaked from the LUT is downright shocking (which, by the way, it should be for most subject associations)" (Strömberg, 1977, p. 5).

What Strömberg was reacting to was the fact that pre-service teachers were to be educated to teach pupils over a wide age span, covering either all of primary, or upper primary and lower secondary. The teachers would consequently follow the pupils rather than be experts in subjects; they would rather have to know a little about a range of subjects (Strömberg, 1977, p. 8).

In the spring of 1978 all the main ideas of the LUT proposal were leaked. There was much common ground between the LUT report and the proposal of a new curriculum for the

Swedish compulsory school that was being written by the National Board of Education at the time, in particular regarding a very progressive view of subject integration. The idea of integrating subjects, especially the science subjects, had gained an increasing number of proponents internationally both in schools, universities and among politicians during the 1970s (e.g. Richmond, 1971, 1973). The proposals for reforming the Swedish compulsory school and teacher education were both heavily influenced by this idea (Prop. 1978/79:180, p. 76).

Not only the ABT but also other subject associations within the social and natural sciences were upset by the lack of knowledge depth that would be acquired by taking the required university disciplines, should the proposed education for teachers in lower secondary school materialise. These subject associations⁵ therefore came together with a joint written statement and a visit to the Ministry of Education, in order to demarcate the boundaries of their respective subject domains. Subject associations normally competed for resources, status and subject domain bounding, which could, for instance, be seen in the layout of the timetable, so this temporary cooperation is interesting (Letter from subject associations to the Ministry of Education, March 15, 1978; Press release from subject associations, undated).

In the existing teacher education established in 1968 each subject taught in lower secondary education required one full academic year of study. The associations were, first of all, very critical of the cut in the study time for each subject in the LUT proposal for the pre-service natural science and social science teachers; it was reduced to three semesters altogether (one and a half academic years) for all the subjects that were taught together in school. Thus physics, chemistry, biology and technology – the latter of which would become a new mandatory subject in the curriculum for compulsory school – or geography, religion, history and social science would get three semesters altogether. This meant only three quarters of a semester per subject, including teaching practice. The resistance to the cuts was motivated in the following way: "The teacher who only has shallow knowledge of the subject domain will all too easily become a slave to the teaching materials [*läromedel*]. The person who feels that he or she has insufficient knowledge will not be willing to hand over the initiative to the pupils to the extent that is desirable and intended in modern teaching either" (Letter from subject associations to the Ministry of Education, 1978, p. 2).

⁵ They were: the ABT, the National Association of Teachers in Mathematics, Physics and Chemistry, the National Association of Geography Teachers, the Association of Teachers in Religion, the Association of History Teachers, and the Association of Teachers in Social Science.

This progressive focus on the pupils' own activity, which also permeated the coming compulsory school curriculum, was not the subject associations' cup of tea. They instead accentuated the significant role of the teacher in the development of the pupils in terms of knowledge progression in the difficult subjects within the natural and social sciences: "For an investigation whose aim it is to achieve better teacher education it should be a self-evident aim to make the teacher well equipped to widen the pupils' perspectives, stimulate their curiosity and satisfy their thirst for knowledge" (Letter from subject associations to the Ministry of Education, 1978, p. 2). In the press release, the associations also emphasized the significance of their common effort – in Gieryn's words, their collective boundary-work:

The signing subject associations should be able to speak about active teachers' need for subject knowledge in today's school work with greater expertise than any other organization in our country. It is highly unusual that *all* subject associations consider themselves to have reason to collectively assert a standpoint. That this is happening now should be taken as a sign that they attach great weight to the quality of teacher education – across all narrow subject boundaries (Press release from subject associations, undated, p. 1).

The LUT proposal came in November 1978. The main ideas of the proposed new teacher education were very progressive regarding compulsory schools; the focus was on seeing the development of the child as a whole. Consequently, the teachers were not assigned to any particular grades but instead had to be able to follow the pupils in one or more subjects or group of subjects throughout primary education or even up to and through lower secondary education (SOU 1978:86; Marklund, 1989).

The proposal was followed by intense work on a response by the subject associations, not least the ABT. The official statement came about a year later, in early 1980, and it commented on all things biological in the proposal. All in all, the statement repeated a great deal of what was voiced in the earlier common letter from the six subject associations, especially concerning the reduced study time in biology for teachers in lower secondary school. From the point of view of the ABT, biology had an exceptional position among the school subjects because of its vast subject content and, in particular, since it concerned "the complicated interplay in nature". If the current proposal materialised the result would be too shallow knowledge on the part of the teachers and they would consequently become poor at carrying out "enquiry- and experiment-based teaching" ("*undersökande, experimentell undervisning*"), an important concept in the new curriculum for compulsory school, *Lgr 80*

(ABT collection, Official statement of the ABT to the Ministry of Education regarding the LUT 74 report, January 14 1980, p. 3; *Läroplan för grundskolan, Lgr 80, Allmän del.*, 1980).

The statement ends in the following way:

Nowhere has the need for knowledge proven to be so strong as within the biological subject domain. To *know* rather than *believe* and *reckon* when it comes to ecology, environment, health and much else has become an increasingly strong demand among many people (Official statement of the ABT regarding the LUT 74 report, 1980, p. 4).

The six aforementioned subject associations continued collectively to comment on different proposals in the wake of the LUT investigation, for example, the integration of natural and social science subjects in the 1980 curriculum for compulsory school. In particular the idea of integrated teaching in biology, chemistry, physics and the new subject of technology, and similarly on the social science side, was a bone of contention since not all teachers were educated in all four subjects (Snidare, 1989; Wicklund et al., 1983). The main criticism against the proposed teacher education also remained; the knowledge acquired by lower secondary school teachers in these subjects would be superficial. By the early 1980s, this was a well-known criticism of the LUT report since many other societal actors had made the same remarks. Together with the economic crisis of the time this meant that the Government Bill regarding new teacher education was postponed time and again (Prop. 1984/85:122 p. 1-12).

At the beginning of 1985 the Social Democrat Government and its minister of education Lena Hjelm-Wallén finally presented the bill on new pre-service teacher education for Swedish compulsory schools. In the bill the time allotted to studying subjects was increased compared to the earlier proposals, so in this respect the boundary-work of the subject associations was successful. On the other hand, the subjects were not considered equal but the study time could vary considerably. At the lower secondary level three academic years were assigned for studying the subjects, but if you were a science teacher this time had to be divided between at least four subjects. In one variant without mathematics, for example, biology and chemistry had to be studied at least one academic year each, but only one semester was devoted to physics and one semester to technology (Prop. 1984/85:122 p. 1-16).

The Swedish Parliament resolved to approve the bill and thus the new teacher education for compulsory school was decided upon in the spring of 1985 (Prop. 1984/85:122, UbU 31, rskr. 366). The Government then commissioned the University Chancellor (now *Universitets-*

och högskoleämbetet, UHÄ) to investigate and report on certain issues to Parliament, in order to implement the reform. About halfway through this work the University Chancellor issued a report to which the subject associations in the natural and social sciences reacted very strongly. They therefore issued another common statement, in which the associations primarily raised the question of the number of subjects in relation to knowledge depth in each subject, because in their view the University Chancellor had glossed over this significant issue. The organizational unity and the integration of knowledge in themes rather than subjects in the new compulsory school curriculum were apparently much more important than integration within subjects. The subject associations were of the view that the Chancellor's report showed a lukewarm interest in "the wholeness which is represented by a coherent study of a subject over a longer period of time of the kind that constitutes the foundation of today's lower secondary teacher education" ("Till Universitets- och högskoleämbetet. Angående UHÄ-rapport 1986:32," 1986/87, p. 235).

In 1987 came the report *New pre-service teacher education for compulsory school*, which constituted the actual implementation document of the political decision to reform Swedish teacher education (Skr. 1986/87:163; *Ny utbildning av lärare för grundskolan. UHÄ:s rapport till regeringen.*, 1987). Apart from the increased study time in the bill, one thing the ABT and the other subject associations may also have been instrumental in achieving is that the new teacher categories were eventually assigned to grades one to seven and *four* to nine, not three to nine. In this way a science teacher did not have to cover more than six grades.

Concluding discussion

The boundary-work that the ABT performed varied a great deal depending on the situation, which is not surprising; it is the nature of boundary-work: "‘science’ is no single thing: characteristics attributed to science vary widely depending upon [. . .] particular goals of the boundary-work" (Gieryn, 1983, p. 792). It is thus possible to discern different types of boundary-work, depending on the goals of the ABT and whether they were dealing with the school subject or with teacher education. In the 1960s, the ABT was expansive concerning the boundaries of biology in the *timetable*, that is, the allotted study time for biology; the subject domain of this "double subject" required more time than just the one academic year in P/UKAS and one and a half years in the 1968 Teacher Education Reform. This was also a dominating form of boundary-work in relation to the secondary school subject. It had to do with more than securing enough time to be able to teach the vast subject matter of biology, which was of course a very central issue. It was also very important to secure the subject in

terms of teachers' jobs, the prerequisite for their professional authority and autonomy. Yet there was seldom explicit argumentation about jobs and working conditions, since in Sweden – and in some other countries, for example, New Zealand (McCulloch, 1992) – this was the business of the teachers' unions, although it was not easy to entirely separate curriculum issues from union issues.

Concerning the *subject matter* the boundary-work of the ABT was generally more restrictive, and tended to guard the subject territory. The model for biology teacher education was certainly the school subject, the subject matter of which was made accessible to pupils and therefore had to be transformed for instruction. Of special significance was lower secondary biology because it also contained so much more than merely the sciences of zoology and botany, for instance, sex education and human biology. In spite of this, pedagogy was not included within the subject boundaries in teacher education; biology teacher education was strictly made up of the biological sciences *per se* and how to teach this (*ämnemetodik*). Consequently, the boundaries were drawn very differently around “biology” as a domain of knowledge in the school and in teacher education, with more emphasis on biology as science in the latter.

Despite this, social science was still seen as related to biology, so much so that it was suggested as a combination in the same way as (and perhaps rather than) chemistry, although it was still not included within the subject boundaries. This should partly be interpreted in the light of the growing societal environmental awareness during the 1960s; something which the ABT picked up as early as the beginning of the 1960s and was now promoting even in teacher education. Ecology was used as a way of bridging the territories of biology and social science (Bowler, 1992; Worster, 1994). It is also conceivable that as social science incorporated more quantitative methods and was gradually more accepted as a *science*, it was also less problematic to promote a closer cooperation with in the school and teacher education by employing a “rhetoric of similarity” (Gieryn, 1999, p. 84). By contrast, representatives of the New Zealand Geographical Society used a “rhetoric of difference” to separate geography as much as possible from history and prevent both being swallowed by the new subject social studies (Gieryn, 1999; McCulloch, 1992).

The reason for the Swedish rhetoric of similarity was that there was no question of the boundaries of biology being erased; the question was just which subjects would be the closest allies. This must also be seen against the background of the removal of the subject of geography from the upper secondary school in Sweden in the mid-1960s. Biology teachers wanted to find a new combination that the former biology-geography teachers could easily

accommodate, and social science was regarded as closer to geography than chemistry in this regard (Hallström, Martinsson, & Sjöberg, 2012). This is an example of what Gieryn calls boundary-work “on two fronts” (Gieryn, 1999, p. 87). When the boundary between biology and social science was blurred the border with chemistry was accordingly made clearer, at least rhetorically. Consequently, it is clear that “social and natural sciences are shaped simultaneously to converge *and* diverge – as circumstances make one or the other representation pragmatic for the pursuit of some identifiable goal” (Gieryn, 1999, pp. 71-72).

The boundary-work of securing as much study time in biology as possible was intensified in the 1970s and 1980s, since there were further cuts suggested in the LUT proposal. There was also the challenge of progressive education, with its focus on subject integration and the pupils’ own activity in the classroom (cf. Lindberg, 2012), which also undermined the ABT arguments about a required minimum period of biology studies in teacher education. Moreover, the whole notion of the importance of the teacher seemed to be in jeopardy. It was even more evident here than in the 1960s that the issue of the study time – always a matter of great concern to the ABT and the other subject associations – had far-reaching implications for the subject content. Without enough time in zoology, botany, ecology, genetics, human biology, etc. the pre-service teacher students could not acquire the knowledge required to be able to teach biology well to pupils in school.

This focus on the individual subject and resistance to all efforts at integrating subjects even within the natural sciences seems to have been commonplace, indeed almost an intrinsic capacity, of subject associations. This can be seen, for example, in New Zealand when geography was to be incorporated into social studies which led to the forming of the New Zealand Geographical Society in 1944 (McCulloch, 1992). In England and Wales in the late 1970s many members of the Association for Science Education (ASE) also opposed ideas of integrated science (Jenkins, 1998), just as members of the Geographical Association in the late 1980s opposed efforts to integrate geography with history (Knight, 1996). Subject integration was arguably even more unpopular with British associations than Swedish ones, symbolized by the ASE’s ambiguous attitude to general science over the years. However, one must remember that the ASE and the GA were still influenced by the public and grammar school tradition. “Education for all” was just being introduced in Britain in the 1970s and 1980s, while it was already quite firmly established in Sweden (Jenkins, 1998; Kent, 2006; Knight, 1996; Layton, 1984).

In conclusion, the ABT was caught in a political struggle for its subject throughout the period of investigation. Depending on the political winds of the time it therefore had to ally

itself with actors such as other subject associations or epistemologically with other subjects, most notably social science, to carry out its boundary-work. Similarly, it also had to distance itself from other subjects such as chemistry in the 1960s and all the other natural and social science subjects in the 1980s discussion about subject integration. In a sense, the subject associations then partly came together in order to emphasize their epistemological differences (Hallström, Martinsson, & Sjöberg, 2012). There was also a longstanding conflict between secondary and elementary school teachers that intensified in the 1960s when both teacher categories came to work in the same unitary compulsory school, sometimes closely as elementary teachers could rise to secondary level through in-service education (Sparrlöf, 2007). Conflicts between different teacher categories are thus by no means unusual in the Swedish educational context, which is why various forms of integration were so central to both the studied teacher education reforms.

The goals of and ways of doing boundary-work were in a sense also strikingly similar over time and resembled those used by subject associations in Sweden and other countries, especially in acting for increased study time in their respective science subjects as well as their resistance to subject integration, in the schools as well as in teacher education. Furthermore, representatives of subject associations almost invariably defended teacher-guided instruction, in the face of whatever instructional method was fashionable at a particular time in the history of science education, usually some kind of constructivist discovery-learning approach (e.g. Kirschner, Sweller, & Clark, 2006; R. E. Mayer, 2004). An obvious conclusion regarding teacher education is that subject associations such as the ABT did not contribute to bridging the gap between subject matter and pedagogy but rather the opposite. Biology teacher education was seen as an academic pursuit carried out at universities, in specific disciplines, rather than at the practically oriented teacher training colleges (O'Donoghue & Whitehead, 2008).

A comparison of ten countries made by O'Donoghue and Whitehead shows that the extent to which the teaching profession has influence over teacher preparation varies widely, with the United States representing one end of the spectrum with no professional regulating body, and certain Canadian provinces with great influence at the other end (O'Donoghue & Whitehead, 2008, p. 195). As a final comment, a hypothesis put forward here is that the place on the spectrum also affects the potential for wielding power by subject associations, since they have been most successful in countries such as Great Britain (England and Wales), New Zealand and Sweden, which could be placed in the middle. In these countries there is enough of a professional infrastructure of teachers' unions and other teacher associations for subject

associations to be able to organize themselves, but there is still not enough professional power over issues such as teacher education; thus the activities of the subject associations, at least during the period of investigation, were effective.

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