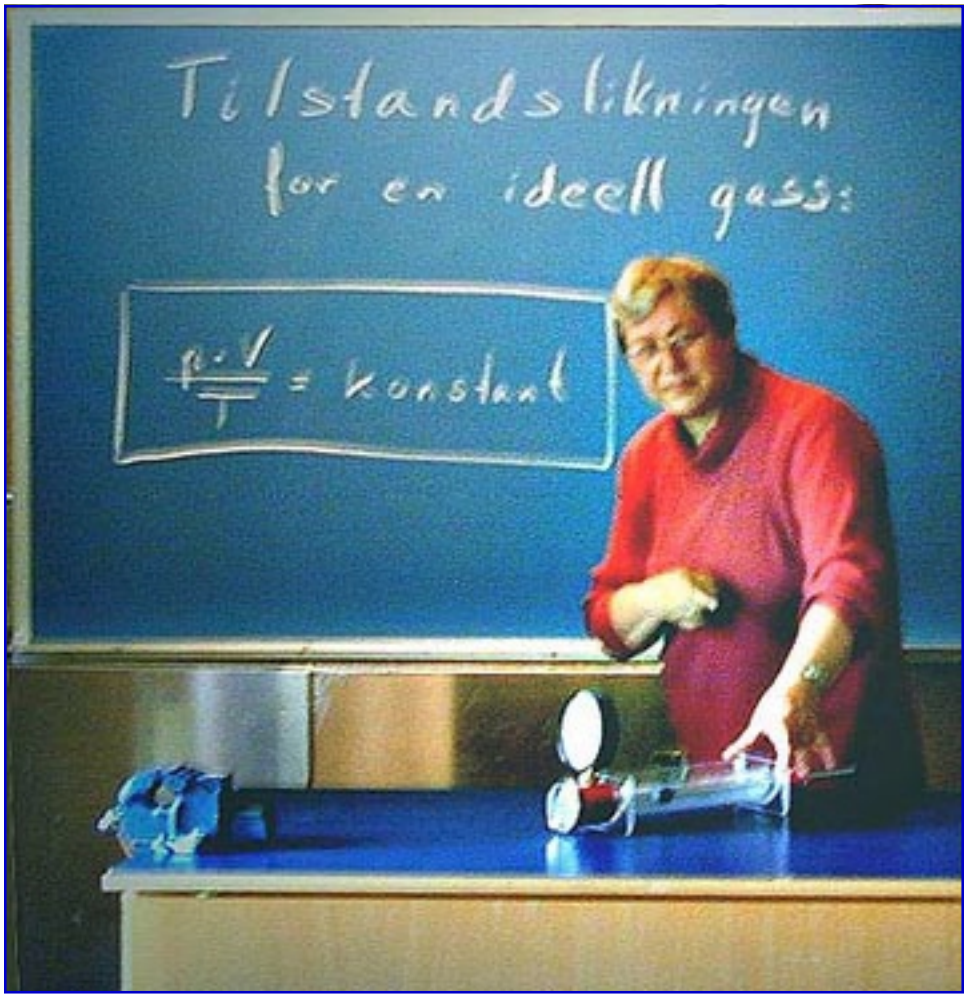

TERMINOLOGY IN THE MAKING: PHYSICS TERMINOLOGY IN NORWEGIAN SIGN LANGUAGE

by
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INTRODUCTION

First let me present myself:

My name is Ingvild Roald. I am a Norwegian woman, and have been teaching mathematics and science, especially physics, to deaf students since 1975.

I have a higher university degree in physics, with mathematics, history of philosophy, religion, general applied education and special education thrown in. Two years ago I was also given the opportunity to take a university level course of Norwegian Sign Language (NSL), the language in which I have been teaching for so many years without any real qualifications.

Presently I am also trying to get my doctorate in applied education: Deaf students and their concepts of physics. I hope to defend my dissertation early in 2001.

Not being a linguist, I nevertheless have been heavily involved in terminology creation in Norwegian Sign Language. The physics part of this is described here, in the hopes that people who are more versed in linguistics than I am, may read and comment upon this. My e-mail address is ingvild.roald@statped.no (work) or iroald@hotmail.com (private).

Having used SignWriting (SW) since the early 1980s, SW is my natural means of conserving and communicating signs when not in eye-to-eye contact with my audience. More about myself can be found at my homepage: http://home.no.net/iroald/ .

And now let me present my school:

The school where I've been working is an upper secondary school for deaf students, situated in the outskirts of Bergen, the second largest city in Norway. Bergen is on the western coast of Norway, and you may read more about the city on this web-site: http://www.uib.no/Bergen/reiseliv/tourist/

The school has students from all over the country. There are several different educations offered at the school, and in 1988 the first students with a university entrance exam of general education graduated. Before that, vocational educations only were offered. Today the school is much changed. Sign language is fully accepted and also taught. The school's name is 'Bjørkåsen', that is 'Birch hill'. You can read more about the school and its programs today at this web-site (some of the pages are in English as well as Norwegian): http://www.bjorkasen.vgs.no/

More than half of all deaf students in Norway get their upper secondary education here. But as Norway is a small country, the number of deaf students is also small, only 30 – 60 students each year in all of Norway (The bureau for national resource centers for special education 1998). Thus the school is not large and the classes are very small, 1 – 8 students to a class.

The two physics classes described in this text constituted about 10% of their age classes, about the same proportions as that for hearing students with physics majors in those years (Editor of FFV 1999).

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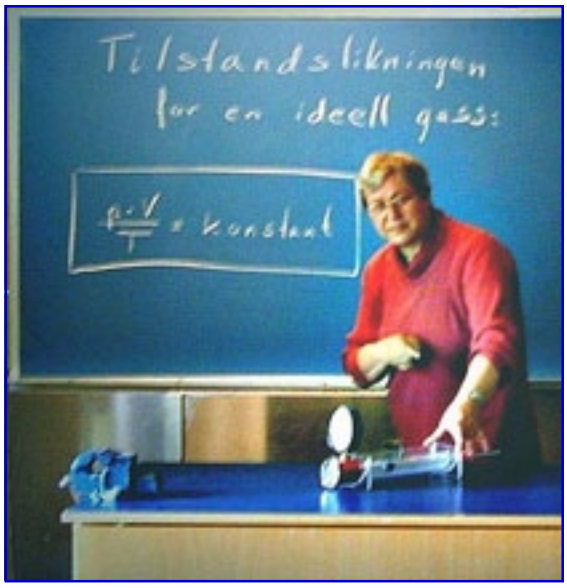


Abstract:
When the first classes of Norwegian Deaf students in Upper Secondary School took physics as their major, no terminology for the more advanced physical concepts existed in Norwegian Sign Language (NSL). This is a description of the process to arrive at a working terminology. The considerations that were taken into account are discussed. Some examples of the resulting terminology are given in the text. A dictionary of the terms is attached.

Background:
Languages in different forms and for different uses

Our everyday world we know about, and we can talk about it in everyday words. Where these words came from is a philological question and will not be dealt with here.

But we all know that new words emerge, out of various subcultures like the teenagers, or out of the need of a group to talk about new things. Computer words are new in all languages, as computers are a new phenomenon. When words for such new concepts are developed in one language, they often will drift over to other languages. This is a phenomenon we see quite clearly today in the computer related words used in Norway, which most often are the English words with a more-or-less Norwegian pronunciation. But attempts have been made to make Norwegian terms for these words, and some of these are in use. – When Norway struck oil in the early 1970s, there was no terminology available in Norwegian for the technology. A project was set up to develop this terminology, and to make it as easily understandable and as Norwegian as possible (Rangnes 1996). That this is a phenomenon that occurs regularly as seen in this quotation from Pitch and Draskau (1985) p. 17:

'Normally, LSP {=Language for Special Purposes} planning is directed towards the development of terminologies which do not yet exist in the language in question, for example many African and other languages: Hebrew, Arabic, Hindi, etc., need to develop terminologies in order to be able to communicate in their own language within a special field of knowledge.'

Science words are mostly made from two roots: ordinary, everyday words get a new, strict definition for use in that particular branch of science; or an entirely new word is made up for the concept in question. When the terminology for a science concept is not derived from everyday words, its is most often either based on the classical languages, Greek and Latin, or made as an acronym for a description of the concept. 'Photosynthesis' is from Greek, 'photos' from 'phos', meaning light, and 'syn-thesein', to bind together. 'Laser' is an acronym for Light Amplification by means of Stimulated Emission of Radiation. This work is often done in a systematic way (Picht and Draskau 1985; Myking 1998).

This means that, in contrast to most of the words we encounter in our daily lives, the conceptual content of a scientific term is often indicated in the term itself.

For sign languages, the root of the everyday word is more often given, or easy to spot. This is called the 'iconicity' of the sign languages. This does not mean that this root is in the mind of the signer or the listener, the signs convey meaning in just the same way as words do, by being associated with a concept in the mind. A child signing 'milk' will think of the white fluid to drink, and not of the operation of milking a cow. But when signing about things in the world that we can see, using signs that we can also see, there will easily be a closer connection between the things and the signs. This has both a positive and a negative side to it.

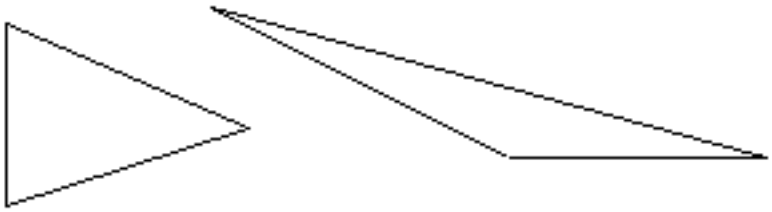
The positive side is that it often clarifies things, and gives the sign language a richness of nuances in expression. From the 'drive a vehicle' sign in Norwegian Sign Language (NSL) you will not only be able to see whether it is a baby tram, a bicycle or a car that is being driven; but you can also see the size of the vehicle and the manner in which it is driven, as well as direction, speed, etc.

On the other hand, there are two points on the negative side:

1) one concept will get conveyed by two or more different signs, according to circumstances. This homonymy, or polysemy, which also occur in our everyday languages, is dealt with in terminology work by the strict definition of which term/s belong to which concept, and terminologists are always trying to avoid this ambiguity (Myking 1998). If a teacher or interpreter for deaf students is not aware of this problem, it can make it difficult for the student/s to grasp the overall concept.

2) the iconicity can be too neat and obvious, hiding the more general content of the concept (one of my students reported a difficulty with the full concept of ‘triangle’, because the sign outlines a neat equilateral one in space, and so the student had difficulty thinking of an oblique triangle). Even if not as obvious as in this case, this problem too is common for all languages, on the interface between our languages for general use and the terminologies, or languages for special use (Picht and Draskau 1985; Myking 1998).

Triangle NSL



Different triangles

The creation of terms for physics concepts in NSL

In the academic years 1984 – 88, two classes of deaf students had science at our high school, with physics as their major. These were the first Norwegian deaf students to get a physics education at that level. Consequently, the signs for most physics concepts did not exist, as no one had needed them before.

In NSL, fingerspelling is not common, except as a first introduction of foreign names (Schrøder 1999). The students needed to be able to talk about the physics concepts both in class and when doing homework. So we needed a terminology in NSL.

It has been pointed out (Caccamise, Smith et al. 1981) that artificial creation of signs is something to be very wary about, and had better not be done at all. If it is done, it should be done with the utmost care, and preferably by a large group of native signers versed in the area in question. On the other hand, terminology for specific use is made by small groups of people in most languages, and may be a necessary means of obtaining a domestic vocabulary for a new subject field (Picht and Draskau 1985; Myking 1998). In fact, fundamental work on terminology in a field has been done by single persons, like Lavoisier in chemistry and Linné in botany and zoology (Picht 1996).

We did not have a large group of native signers who knew physics, and I myself as the teacher, was at that time barely adequate as a signer (Roald 2000, submitted). But the students and I worked together in class to find ways to sign the concepts that would neither clash with the concept itself, nor with ordinary ways of using NSL (the latter constriction was eased in a few instances, when the concept and the word for it was so outlandish we thought the sign might be outlandish as well). The former students are now adults, most of them teachers themselves, with responsible positions in the Norwegian Deaf Association, and they state that for the purpose of creating a terminology for use in a special field, the procedure we followed was fully acceptable (Roald 2000, submitted).

Before attempting to come up with signs in NSL, I had tried to find out what was available in American Sign Language (ASL), in Finnish Sign Language (FSL) and in Gestuno, the sign equivalent to Esperanto (Oglia, Caccamise et al. 1990; Komiteanmietintø 1975; norsk/nordisk tegnspråkutvalg 1976); Gestuno (1975). Of course I had also sought the advice of experienced deaf signers of NSL. In the course of this research, I had been invited to partake in a group appointed by the Norwegian Deaf Association, finding appropriate sign terms for mathematics. Results from this work can be found in a booklet (Tegspråkutvalget 1985) and is incorporated in the official NSL dictionary “Norsk Tegn-ordbok” (Tegnspråksutvalget 1988).

Some of the principles from the foreign sources we could use, but others where not immediately adaptable, because the intrinsic features of the sign languages in question did not coincide with parallel features in NSL. Some examples of this will be shown and discussed later in this paper. In Norway, physics language uses a lot of English-derived terms. Our initial goal was to utilize as much as possible of ASL terminology. Because of the differences in basic characteristics of ASL and NSL respectively, this goal could not be fulfilled.

Whenever the class met a new concept, that concept was explained and discussed in detail, most often with hands-on experiments. The Norwegian word for the concept was given, and effort was also made to find out what other things that word might mean (if it was an everyday word), what other words that might resemble it and mean almost the same (like derivatives of the word), and what words might resemble it, and must not be confused with the one in question. If the word was constructed from Greek/ Latin or an acronym, they were analyzed on that basis as well. Similar methods are used in terminology work in general (Picht and Draskau 1985; Myking 1998).

EXAMPLE 1 from a lesson on fields of force:

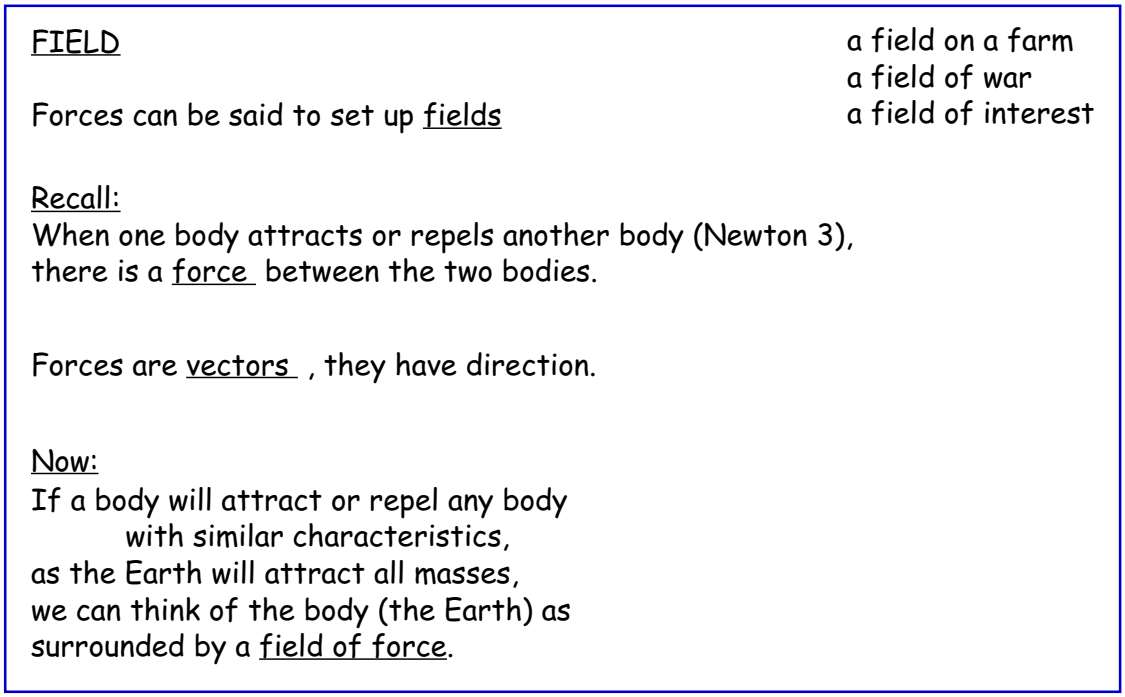


Figure 1:
The blackboard a short time into the lesson (translated)

The theme is in the upper left hand corner, the words to be associated – or not associated – with it, in the upper right hand corner.

A reminder of former concepts that would be needed to grasp the new one, are placed under the theme.

The description of the theme, under "Now:", would be explained by sign before it was written.

Then a further description, most often with a drawing, would follow: (see fig. 2)

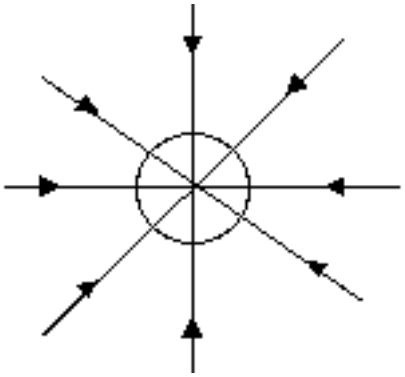
FIELD

a field on a farm
a field of war
a field of interest

Forces can be said to set up fields

Recall:
When one body attracts or repels another body (Newton 3),
there is a force between the two bodies.

Forces are vectors , they have direction.



Now:
If a body will attract or repel any body
with similar characteristics,
as the Earth will attract all masses,
we can think of the body (the Earth) as
surrounded by a field of force.

To represent this field, we make drawings.
The direction of the force is indicated by the field lines
The strength of the field (the force on 1 kg mass) at a given point,
is indicated by the density or spacing of the field lines.

Figure 2:

The blackboard later in the lesson

The “other uses of the word”, in the upper right hand corner, would all be signed as “area”. The discussion of the class would soon reveal the inappropriateness of this sign to convey the concept of a force field. The suggestion would be a new sign, with both hands apart, fingers spread, coming down and together with fingers closing in at the middle.

Field/ area

Central field

It would now be time to introduce a variation of the theme: the gravitational field of the classroom. The pupils were given forcemeters (coil springs with a scale) and a load of some sort, and asked to climb tables with their arms high, and to get close to the floor, on different locations in the room, to see that the reading on the forcemeter for this load was actually the same all over the room (this was done fast and with a bit of laughter, as they supposed that the outcome would be ‘no difference’). The blackboard that was a result of this exercise, is depicted in figure 3.

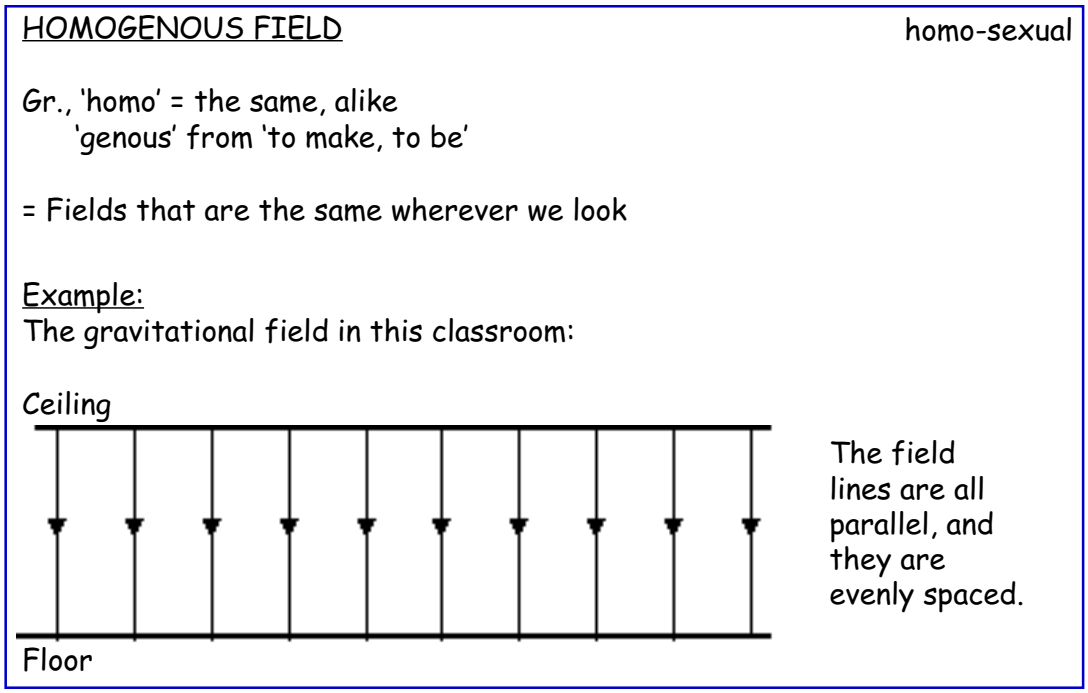


Figure 3:
The blackboard after it has been wiped clean and filled again, in the same lesson

The discussion following this example generated a sign where both hands are held rather high, palms down, fingers spread; and then the hands moving downwards without changing the spread of the fingers. (This sign is closely related to the sign for ‘rain’, and the strings of rain resembles the field lines of a force field). This would become the general sign for a force field. A similar, but modified, sign would be used for horizontal, homogenous fields. The ‘homogenous’ would be left out for most uses, but if needed, it would be signed as “like through”. The sign describing the gravitational field of the Earth, would be used to designate central fields.

The direction of movement would indicate the direction of the force.

Rain

vertical field

horizontal field

homogenous vertical field

Sign discussion completed, the class went on to a laboratory exercise on magnetic fields around magnets of different shapes. Another day would bring an exercise on electrical fields between electrodes of different shapes.

THE SIGN NEGOTIATIONS

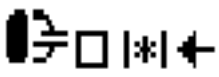
Whenever a new concept was brought up, the concept was explained and discussed in a similar way. Then the available signs were discussed: if the word in Norwegian was an everyday word, could we use the corresponding sign? Or one of the corresponding signs if there were more than one? What about the ASL sign? The Finnish sign? The Gestuno sign (if there was any)?

The class, with 4 to5 students, did most of the discussion. I might correct them if they seemed to have the concept wrong, or I might suggest something myself if they seemed stuck. The procedure, as seen from the students' point of view, is also discussed in my paper 'Deaf teachers talk about science education' (Roald 2000, submitted).

We went through the same procedure in the two consecutive classes, but for the second class my suggestions (after the class got stuck) usually were the signs used by the class before. – In most instances the second class agreed with the first class. The resulting dictionary, written in Sutton SignWriting, contains both signs where they differ. Many signs seem to have stuck, those which are relevant are seen from time to time on the signed programs on television.

This was laborious work, and the first class got credit for it (about 20 hours in one year). The second class did not get credit, but this tough work was certainly part of what got them good grades (Roald 2000, submitted).

But even with these thorough discussions, we sometimes came up with strange situations. In one instance, we were discussing (electrical) charge. I suggested the sign "battery", which also may mean "charging a battery". Everyone agreed. Two minutes later, one of the students turns to another and without thinking uses another sign, which was conceptually better. (The index and middle finger placed on the outside of the closed O-hand, like resting there. It also conveys the fact that in metals the charge is on the outside of the sample.) These sorts of happenings are not uncommon in terminology work. They have to do with the motivation of the terminology makers, and will call for re-negotiation of the term agreed upon (Myking 1998). We settled for the second sign.



battery/charging

electrical charge

Rules we made and followed:

We tried to make our own rules, and be consistent to an extent.

EXAMPLE 2: ELECTRICITY

The everyday sign ‘electricity’ is index and middle fingers together, slightly bent, in both hands, tapping / contacting each other twice. This is close to the everyday sign for ‘contact’, which taps once.

electricity

contact

We kept the sign for ‘electricity’, but restricted it’s meaning to the phenomenon, not the power or other everyday inferences of the word/sign. We also kept the combined index/ middle finger for further electricity concepts. Thus we combined the movement of the sign for ‘stream, current, river’ with this handshape, and got the sign for electrical current (in Norwegian, the word is ‘stream’). This the same as the GESTUNO sign for ‘current’.

stream, current, river

electrical current

Keeping the two hands in the ‘electricity’ position, but a bit apart, and straining/ shaking, we got a sign for ‘voltage, potential’ (which in Norwegian has a word meaning ‘emotional suspense’ or ‘strain’).

Voltage, electrical potential

‘Contact’ between two pairs of conductors were kept as the everyday sign (as when you connect a plug to a socket), but contact between just two conductors, as you often have to do in laboratory work, was signed with just one of the fingers on each hand. A short circuit was signed with the index finger of the dominant hand coming across the two fingers of the base hand.

contact between two single cables

short circuit

EXAMPLE 3: ATOMS AND ATOMIC PARTICLES

For atomic concepts, there were two every day signs for atom, one meaning ‘small’ or “tiny” and one meaning ‘bomb’. The latter was most in use. (Our students generally got scared when told they had atoms inside.) None of the above could serve our purposes in physics. We decided to deviate from the standard way of signing in Norwegian, by using the extended little finger on the left hand as the center of movement for signs about atoms and atomic particles. We further agreed to use a device not commonly used (though not unheard of) in NSL: initialization. This means that we used the handshape of the first letter of the Norwegian word for the concept. In addition, as is usual in NSL, the Norwegian word was mouthed unless the sign called for a special facial component.

On the other hand, in our sources of foreign sign languages, we found that the group of atom-related signs, for instance, are quite similar: The NSL signs that we adopted were like the Finnish signs in that they all circulated the little finger of the secondary hand. The main hand would take on the handshape of the initial letter of the term (in Norwegian). In ASL, both hands will take on the initial letter’s handshape (Oglia, Caccamise et al. 1990). In ASL later development has caused another set of signs to appear, letting the initialized main hand circle the secondary hand in A-handshape (Caccamise and Lang 1996). In NSL and FSL the nuclear particles would start by circling the little finger, and then go to the middle of the palm of the secondary hand. In ASL, the initial letter in the dominant hand is shaking side-to-side, alone or inside a cupped secondary hand (Caccamise and Lang 1996). –A Nordic symposium in 1975 had decided that ‘atom’ should be like the official NSL sign, but in the composite signs ‘atomic energy’ and ‘atom reactor’ we find the FSL sign, that we at Bjørkåsen adopted (norsk/nordisk tegnspråkutvalg 1976).

atom NSL
official sign

atom NSL
common sign

atom NSL
our sign

atom ASL

atom FSL

Signs derived from the atom sign:

ion NSL

ion FSL

ion ASL

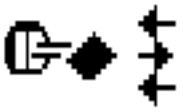
Electron NSL

Electron ASL

Proton NSL, FSL

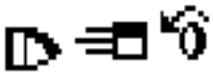
Proton ASL

Neutron NSL, FSL

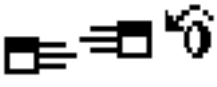


Neutron ASL

For ‘molecule’, we used a similar movement, but changed the handshape of the secondary hand, in accordance with the Finnish and the Gestuno signs:



Molecule NSL, FSL, Gestuno

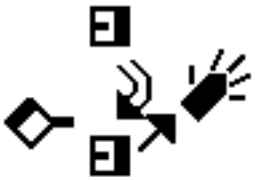


Molecule ASL

The atom could be exited by raising the “E”, and de-exited by lowering the “E” (the excitation of an atom implies that the energy is raised and an electron get to an orbit farther from the nucleus). If the de-excitation was followed by an emission of radiation, the “E”-shape would change to an outward burst at the end of the movement.

Excitation
(of an atom)

de-excitation



de-excitation
w/emission of radiation

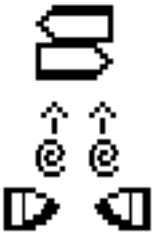
Some of the principles from the foreign sign languages were not easily adaptable. For instance, in ASL the sign for ‘element’ is based on the sign for ‘basic’, which is a B-hand circulating under a flat hand. Thus in ASL the ‘element’ sign becomes an E-hand circulating under a flat hand. In NSL, “basic” is one flat hand on top of the other, and “element” in Norwegian is a composite word, ‘grunnstoff’ composed of ‘grunn’ meaning ‘basic’ and ‘stoff’ meaning substance. Our NSL sign “element” became a composite sign, “basic”+ “substance”.

Basic ASL

Element ASL

Basic/basis NSL

Substance NSL



Element NSL

In this way we worked through all the chapters of the curriculum, and the dictionary now has signs for almost 800 specific terms of physics, of these more than 400 are created at Bjørkåsen by these classes, as can be seen in the attached dictionary. There are more synonyms than would ordinarily be seen as ideal, because of NSL's own synonym richness based on history, and because of the borrowing from Norwegian spoken/ written language, resulting in composite signs from composite words. The dictionary also contains some of the everyday signs that the physics signs are derived from.

Conclusions:

Even if the transparency of the science terms may not be evident to the lay person, a teacher of the subject should be aware of this, and it is possible to take advantage of this fact in guiding the students to the understanding of the concept underlying the term. There is a link between the representation of a concept and the concept itself, even if this is not always evident (Picht and Draskau 1985; Myking 1998).

The work that these classes did on the NSL terminology of physics was in accordance with the general principles of terminology creation, as these are outlined by Pitch and Draskau (1985) and in the Nordic Minisymposium on Terminology (Myking, Sæbøe et al. 1996). Even if no linguist was present and the students were not experts in the field for which they were making the terms, they based their term making on the conceptual content and the principles of NSL, or principles that the classes themselves laid down for this class of signs.

Finally, another quote from Picht and Draskau (1985):

'For the organization of knowledge, it is essential for people to be able to make themselves understood through the medium of language. But language can only fulfill its task if the concepts are defined and related unambiguously to the terms.'(p. 178)

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July, 2000

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