What is a good chemistry teacher?!

- It depends on the teacher

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Abstract

In March 2014 we have lectured for the second time at the HCMCUE. We have been invited from the Department of Chemistry in order to talk about the question: What is a good chemistry teacher? The lecture was our answer, look to the exclamation (!). The question sounds very simple, but indeed the answer is very complicated. Our answers are depending on our personal attitudes. We connect the new lecture with the lectures last year. The answers are also meaningful concerning the Vietnamese education reforms.

Keywords: chemical education, teacher behaviour, pupil orientation, professionalization

Tóm tắt

THẾ NÀO LÀ NGƯỜI GIÁO VIÊN HÓA HỌC GIỎI?!

Vào tháng 3 năm 2014 chúng tôi đã giảng dạy lần hai tại Đại học Sư phạm Thành phố Hồ Chí Minh. Chúng tôi đã được mời bởi Khoa Hóa học để nói về câu hỏi sau: "Thế nào là một giáo viên Hóa học giỏi?!" Các bài giảng chính là câu trả lời, hãy nhìn vào dấu chấm than ở câu hỏi (!). Câu hỏi nghe có vẻ đơn giản, nhưng thật sự câu trả lời rất phức tạp. Các câu trả lời phụ thuộc vào thái độ của mỗi cá nhân. Chúng tôi đã liên hệ bài giảng năm nay với các bài giảng năm trước. Các câu trả lời rất có ý nghĩa trong bối cảnh đổi mới giáo dục tại Việt Nam

Từ khoá: giáo dục hóa học, hành vi giáo viên, xu hướng người học, chuyên nghiệp

1. Our thinking and our attitudes

First of all we want to fix our positions. It is not about right or wrong but it is about education philosophy. "Good" could mean, the teacher...

- fulfills the curiculum
- provides chemical knowledge
- wakes interests of the pupils
- encourages and challenges pupils
- considers everydaylife
- considers pupils potential
- captures teaching situation

What good is depends on the viewing perspective, therefore good is relatively. Our perspective of respecting learners could be absolute right (compare 2.2). With our lecture we want to sensitize but not criticize. We solidarize with teacher problems in order to strengthen the awareness of teacher. We want to create readiness for changes, while we focus and prefer pupil orientation. With this awareness we give some constructive answers.

2. Chemistry teacher: central factor of chemistry teaching

2.1. How is the chemistry teacher behaviour at present?

The teacher is the most important factor in chemistry teaching. He can every day experience learning processes of pupils, and he should reflect these. He seems to be a real expert of chemistry teaching. Teaching behaviour is focused worldwide.

It is said that teacher behaviour has **indirect** influence on popularity of chemistry teaching, on the less acceptance of chemical education and on the failing education process. But chemistry itself already has got a negative image. All of the **direct** results, most of them evaluated by pupils, show a not so positive image of chemistry teacher. This effects that chemistry teaching is rather denied than preferred. School subject teacher have been ranked in a popularity scale from 1994 in Germany [1]. The chemistry teacher was ranked at 11th of 13th positions (physics teacher on 12th, biology teacher on 3rd). We are not aware of new data. Results in the Vietnamese context would be interesting.

It is not surprising that the correlation between popularity of chemistry teacher and chemistry teaching is high, but it is difficult to decide the determination of both variables. Beside these results there are differentiated results:

- popularity of chemistry teacher decreases with increasing age of pupils
- girls like chemistry teacher less than boys
- differences of popularity exist between different schools

It seems that chemistry teacher have a great effect on the popularity of chemistry teaching. There are big differences between results of single schools concerning the popularity of chemistry teaching. Also talented pupils that like chemistry evaluated chemistry teacher not only positive but also negative.

There are various techniques in order to research personal factors of teacher behaviour. A standardized technique is the **polarity profile** technique (compare Attachment). Another one is researching **stereotypes**. It would be also possible to research **children drawings**. **Questionnaires** and **tests** use given preknowledge in order to confirm or to develop theories about chemistry teacher. The **observing** of chemistry teacher behaviour can be recorded and analysed. **Action research** start from the knowledge of the chemistry teacher extracted from the own teaching. Teacher **modelling** based on research need to be confirmed in real and situational behaviour of teacher.

Popular teacher and unpopular teacher differ a lot. There are contrasts between both in personal as well as in didactical characteristics. The popular chemistry teacher is more helpful, trustful, calm, cheerful, fair, humorous - in a view on personality. He is also flexible, a good specialist, imaginative, successful, motivating, good explaining - in a didactical view. We illustrate this with single results about teacher behaviour (compare Tab.1).

Tab.1 Worldwide results about teacher behaviour (selection)
nature science worldview as only objective truth
high chemistry competence
subject structured teaching
cumulative knowledge mediation
abnegation of situative teaching
abnegation of application
less social competence
disregarding understanding problems

There are no indicators for pupil orientation and there is no awareness for learning processes. Of course influences from outside on teacher behaviour like curricula, abstract content, resources and education system should also be regarded (compare 2.2).

In general chemistry teacher have a more positive image of themselves. Asking pupils might present another image. In one point both perspectives agree, that the subject competences of chemistry teaching is high. The positive self-image of teacher prevents a realistic sight of his behaviour. This is very problematical concerning a changing behaviour towards pupil orientation, in our view the most important factor for a good chemistry behaviour.

We do not want to comment and criticize, but we have the duty to make aware of pupil orientation and to increase the popularity of chemistry teacher [2]. These are important factors for a better chemistry teaching.

2.2. Professionalization of chemistry teacher behaviour!

The question how to professionalize teacher training is very old and traditional, a lot of answers have been given through empirical researches and various programs of teacher training that reflect social conditions and social duties. One social duty is to refer to the pupil, this means to provide pupils a guide for life through teaching.

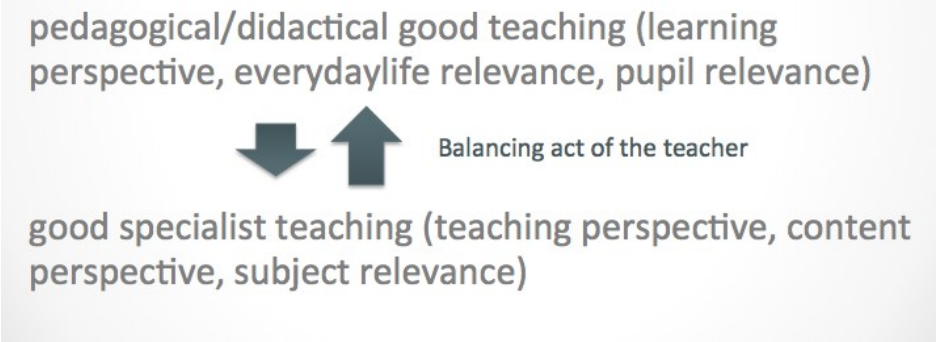
Pupil orientation must be a philosophy of teacher training and a direction of teaching. The philosophy includes metatheoretical attitudes and positions:

- reflection of teaching and behaviour
- orientation on interests of pupils
- stimulation for thinking and operational processes
- imaginations of pupils as teaching stimulus
- acceptance of learning difficulties of pupils
- repertoire of teaching measures
- repertoire of diagnostic/differentiation techniques
- feedback for pupil
- learning environment in trustful atmosphere
- adaptive self competence (increasing by experience)

Especially the repertoire of diagnostic/differentiation techniques is a great topic of teacher training in Germany at present. For this it is necessary to accept the preferences of pupils concerning the conceptions. There are two main directions. One direction is the scientifical conception and the other direction is the everydaylife conception. For pupils the most prefered one is the everyday life conception (compare 3.3 and [2] [3]).

Teacher training as a professionalization process means the orientation on the pupils as customer and therefore on learning and performing processes of the pupils. Pedagogy, psychology, didactics, chemistry need to be integrated in teacher training. Training processes at all levels, systemreforming, resources are chances for a professionalization but this is also a great challenge. These measures (structure and content decisions) create an identity with the aimed profession. A good chemistry teacher behaviour mirrors a repertoire of behaviour competence like the current research situation shows: "knowledge" (e.g. in chemistry, didactics, pedagogy) and "skills" (situational acting) are the base of a behaviour model with that real chemistry teacher behaviour can be evaluated. At the moment there exist no results concerning the effect of the model factors on good teacher behaviour.

But we still think that the best result of a professionalized chemistry teacher training should help teachers to balance between pedagogical and specialist teaching. In our opinion the balance should consider the pedagogical perspective more, but teacher must balance this equilibrium by themselves depending on the situation in chemistry teaching (compare Img.1).



Img.1: Goal of professionalization: teaching as a balancing act

Such a teacher training can make aware for effective, pupil orientated, situational teaching in a confident learning atmosphere.

Of course the professionalization process is not simple. Teacher training has limited chances. Training must allow students practical experiences accompanied by professional experts and coaches. By this it is possible to extract the thinking or beliefs of the students. Teaching problems and goals must be thematized. Methods and conceptions as differentiated teaching tools should be seen as help for teaching later. In addition self-activity should also be a goal of training. In Germany there are several approaches practized, e.g. students can proof research results in teaching practice. So they can understand different theoretical positions. Collaborations between lecturers and students could also be strengthened, this could be optimized by participation of teachers.

All these thoughts do not neglect that there are other influences on teacher behaviour. For instance there are many expectations on the teacher from different directions. Teacher also must fulfil a lot of different tasks beside their teaching. Acceptance and resources are also influencing the teacher behaviour. This needs to be improved, perhaps by an higher salary.

2.3. Professionalization of chemistry teacher behaviour! - Perspectives for the Vietnamese education reforms

In connection to the Vietnamese situation the professionalization towards a pupil orientated chemistry teacher are very meaningful [4]. The education reforms include changes of chemistry teaching. Most important is the focus on pupils personal skills, self-activity of pupils, reduction of abstractions and application for everydaylife. That means indirectly a change of teacher behaviour and thinking.

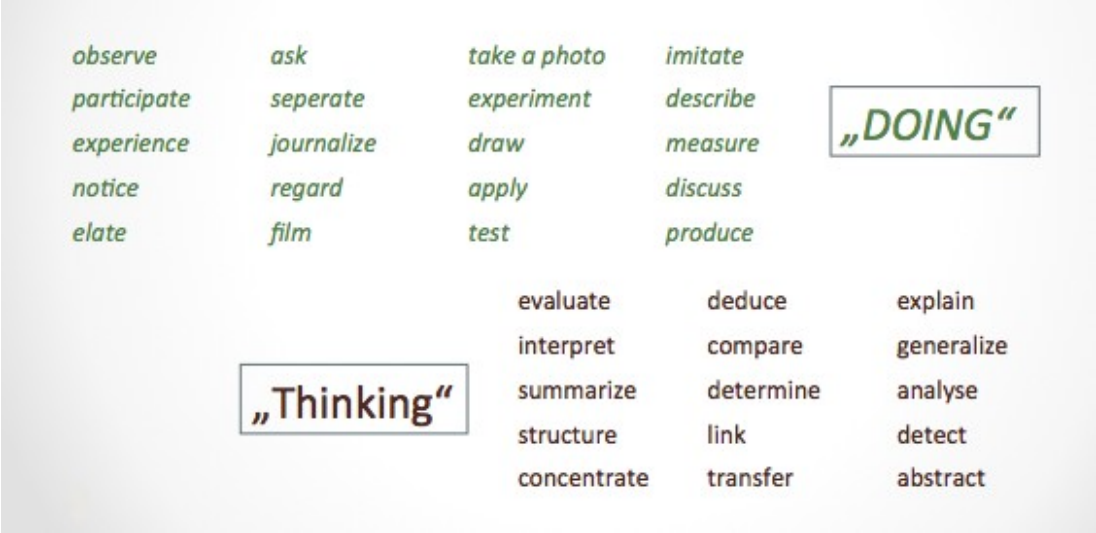
In the public media we have noticed several discussions about pupil orientated approaches, for example about discovery-based learning [5], constructivist teaching processes [6] and context orientated teaching [7]. Ngan has presented suitable context situations in order to connect the theory in chemistry schoolbooks with its life relevance. In this we see first steps towards pupil orientation. The discussions has shown us that there is an awareness for pupil orientation and therefore chances for its professionalization in Vietnam.

3. Creating learning impulses: a traditional perspective

3.1. Indicator for a good chemistry teacher in general

A good chemistry teacher ...

is flexible, situational versatile, focuses pupil activities (operations, cognitions) (compare Img.2) and attitudes (interests, popularity). He should help pupils to understand, like Confucius has requested. Both different activities must be combined, while it is necessary to regard that pupils prefer different activities. Activities like noticing and experimenting are positively evaluated by pupils (compare Img.3). Although journalizing and describing are important scientific activities pupils do not prefer them.



Img.2: Learning impulses: possible activities

A good chemistry teacher should also plan, rethink, concretize, evaluate learning processes. With these factors he has great situational potential. Later in the article we will give some examples for that. A good chemistry

teacher must tie on the experiences of the pupils and on well-known situations in everydaylife. We do not interpret the chemical phenomena and we do not represent standard ways of teaching with standard experiments. We have decided to show this on the themes soap and washing, but of course it is suitable for any other theme too. In our eyes this topic is regarded pretty short in Vietnamese chemistry teaching, although this theme has great cultural and social relevance.

With the following picture you can test by yourself, how you would react in this situation, if you were a chemistry teacher or lecturer or teacher student?

Img.3: "May I do it?"

3.2. Indicator for a good chemistry teacher in special

For a concretion of a pupil orientated everydaylife conception we have listed some suggestions based on theoretical principles:

- Helping pupils construct and reconstruct knowledge
- Finding problems and solutions with pupils
- Understanding pupils imaginations and previous knowledge as stereotypes, difficulties and help
- Recognizing the meaning of chemical terms as learning difficulties
- Making aware of cognitive conflicts between scientific explanations and everydaylife interpretations
- Illustration and verbalization of phenomena, notice, observation, interpretation
- Especially noticing experiments as targeted observing

- Involving out-of-school learning environments
- Using eveydaylife communications as situational motive
- Using differentiated competence and relevance levels
- Contrasting experience (daily life) with experiment (chemistry) as methods of awareness
- and much more

The practical possibilities concrete the theoretical aspects. They are versatile and their usage should depend on the situation:

- Thematizing simple everydaylife experiences
- Thematizing communication in everydaylife about chemistry
- Comparing everydaylife substances with similiar functions
- Implying and analysing product informations
- Planning and executing simple pupil experiments
- Differentiating everydaylife terms
- Transforming everydaylife experiences into experiments
- Developing scientific explanations of everydaylife experiences
- Allowing instrumental constructions by pupils
- Illustrating chemical everydaylife terms by experiments with everydaylife substances
- Using everydaylife instruments, equipment and operations for nature science
- Finding playing impulses
- Using public media in order to get an access to chemical problems
- and much more

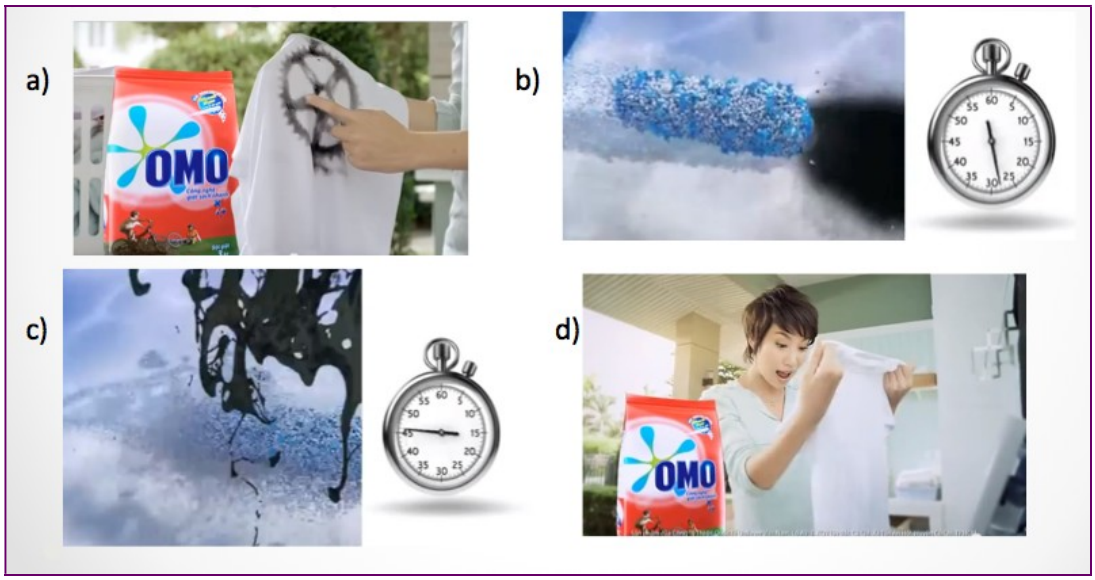
3.3. Learning impulses: communications + imagination

Public media provide a lot of learning impulses (e.g. in newspaper, tv, internet). Communication and imagination about chemistry can be experienced everyday in commercial, e.g. for laundry detergent. We will focus on the washing processes presented in a well-known OMO commercial in order to show which learning potential a commercial video could have for

chemistry teaching. The usage of this video is versatile. A lot of aspects that can be seen in this video could be thematized in chemistry teaching.

The washing process in this video is seen as an experiment. It shows phenomena from the daily life, experiences, interpretations of the washing process. The commercial tries to describe the chemical process with everydaylife terms and analogies.

We have extracted four moments of this video. These moments symbolize basic steps of an experiment. Pupils could see methodical aspects of science and chemistry:



Img.4: Learning impulses: moments of the film

Picture a) shows the awareness of the problem by sensory testing: the form of the dirt makes clear it is mineral oil.

Picture b) shows the execution of the experiment with well decided measures.

Picture c) shows the ending phase of the chemical process. The dirt spot is separated from the textile. The dirt spot is removed and destroyed.

Picture d) shows the assessment: the problem is solved. The shirt is clean again.

In this video there are analogue interpretations: The washing detergent is moving like a bullet with physical power in order to remove and destroy the dirt. It shows a physical and mechanical imagination. There is also an imagination of reaction speed. It is symbolized by the clock placed next to the washing process. The differentiated structure of the bullet shows an imagination of functions of different substances. The laundry detergent seems to consists of different substances that only react with the dirt but not

with the textile. After the dirt was separated it disappeared. This represents an imagination of destruction.

This video provides versatile learning impulses. You can let your pupils experiment and experience this washing theory by themselves (compare 3.5.) You can thematize and discuss about the explanations and interpretations given in the commercial. Pupils could evaluate the shown imaginations compare them with scientific chemical imaginations. Of course it is also possible to discuss the cultural importance of the washing substances, like their meaning in the household, hygiene, economy and environment.

A good chemistry teacher also ties on the imaginations of the pupils. Research results show that pupil's imaginations are influenced by commercial but not by chemistry teaching. Therefore the teacher must extract and problematize these imaginations in his teaching. In general pupils have a material imagination connected to functions and properties of substances, but they don't have chemical imaginations (particles, discontinuity). You can use **discussions** in different ways, **drawings** in order to extract the pupil's imagination.

3.4. Learning impulses: experiences

All everydaylife conceptions must consider everydaylife substances, everydaylife activities, everydaylife imaginations and everydaylife applications.

Most of their experiences pupils make through communication. On the internet there are a lot provided about chemistry in daily life, e.g. communication on the level of customer tips, customer knowledge and customer problems. This great and new potential provided by the internet should be used for chemistry teaching.

The following example of customer tip is about the addition of acetic acid or citric acid to rinsing agent in order to get better cleaning results:

„Ấm chén: Để việc rửa nên dễ dàng hơn, bạn hãy thêm vài muỗng giấm hoặc chanh vào nước rửa chén. Giấm sẽ giúp tẩy sạch dầu mỡ nhanh hơn, đồng thời khiến chén đĩa trông sáng và sạch hơn.“
(http://doisong.vnexpress.net/tin-tuc/noi-tro/meo-vat/don-dep-nha-dung-cach-de-don-xuan-2945170.html)

It might be new for pupils but in chemistry teaching pupils can interprete this suggested washing operation or they can try to explain the described effect with their preknowledge and experience. This customer tip can also be used as an introduction for a pupil experiment. They can evaluate the presented

washing operation and in addition pupils can develop further experiments based on these new experiences.

Especially customer problems can be used as authentic learning impulses for chemistry teaching. The following problem question was put on an internet forum. It is about how to remove an oily dirt spot on clothes:

"Làm sao để tẩy sạch vết dầu (ở xích xe đạp, cửa sắt) trên quần áo?" (https://vn.answers.yahoo.com/question/index?qid=20091107045450AAMb3Wx)

Two different answers have been given. The first one suggests to use pork fat and than detergent, while the other advices to use petrol and than detergent in order to solve and remove the spot:

1) *"Dùng mỡ heo (lỏng) đổ lôn, vò, sau đó đổ xà phòng bột lên giặt lại, sạch bong ngay."*

2) *"Bạn thử dùng xăng để rửa trôi vết dầu, sau đó giặt lại áo với xà phòng và nước xem sao."*

It seems that there are different ways how to solve this problem. The answers of both authors show different everydaylife experiences, realities and theories. Pupils could try to explain these methods from a chemical perspective.

In all communications there are no chemical imaginations and explanations. The writer have got their own theories of problem solving. All these can be used as learning impulses for pupils, e.g. they can imitate and experience by their own, create ideas and develop model experiments, analyse, describe, explain, interpret, evaluate and compare all the given phenomena with their own experiences, knowledge in order to approach the chemistry. Learning difficulties like imagination of particles and solving need to be considered and thematized. Besides all activities we have mentioned before, these given answers can especially be used as experimental inspection for pupils. Pupils can experience by their own the effects, develop own experiments in order to see advantages and disadvantages of the described cleaning methods. The next step would be to interpret and explain their observation and new experiences.

In order to help pupils to learn about everydaylife substances it could also be useful to thematize product information. Pupils can look up and learn by themselves about the ingredients and their functions in soap, laundry detergents and other washing substances through books or internet.

Visiting a soap manufacturing could also be a helpful learning impulse. Experts can explain pupils their experiences, imaginations of soap or detergent and its production. They know about production difficulties,

conditions and about what needs to be regarded by producing and handling with soap.

3.5. Learning impulses: experiments

For a pupil orientated approach it is necessary to respect experiences of the pupils, at the same time it is possible to develop chemical questions and problems from these experiences. Therefore it is important to plan and execute the experiment, while the daily life experiences (doing and thinking) are the basics for them.

These are just some questions from everydaylife, we have collected:

1. *Why do we use soap to clean our hands?*
2. *Why is it difficult to remove oil from the hands with water?*
3. *Why is it harder to get off the soap foam by washing hands with rain water?*
4. *Why does soap water foam?*
5. *What are your experiences with foaming soap water?*
6. *Where do you experience water hardness in everydaylife?*
7. *How would you remove a grease spot (mineral oil, ink) from textiles?*
8. *How does a laundry detergent work?*
9. *What imaginations of washing process have you made in daily life?*
10. *What are the differences between soap and laundry detergent?*
11. *What are soap bubbles?*
12. *Why do we clean textiles with laundry detergents?*
13. *Have you heard about disadvantages of soap?*
14. *Have you ever seen insects walking on the water surface?*
15. *How is it possible to increase the moistening by detergents?*
16. *Is soap a cleaning substance for everything?*
17. *Should we clean our hair, face, dishes by soap?*
18. *How can soap be produced?*

Suitable experiments for pupils should connect to these questions. This is also an indicator for a good chemistry teacher. A teacher should keep in mind that experiments must be developed from the perspective of the pupils.

Behind all these questions there are important chemical terms in the context of detergents: tenside, soap, detergent, functions and effects of detergents, micelles, water hardness, surface tension, interaction with dirt on textile. These terms are not visible and not clearly to understand. Therefore they must be thematized and be connected to phenomena or they must be developed from phenomena.

In our lectures we have presented three simple experiments developed from the experiences of the pupils. Therefore we have thematized the experiences in a chemical way. The experiments have been executed with simple equipment, especially those that are used for daily life operations.

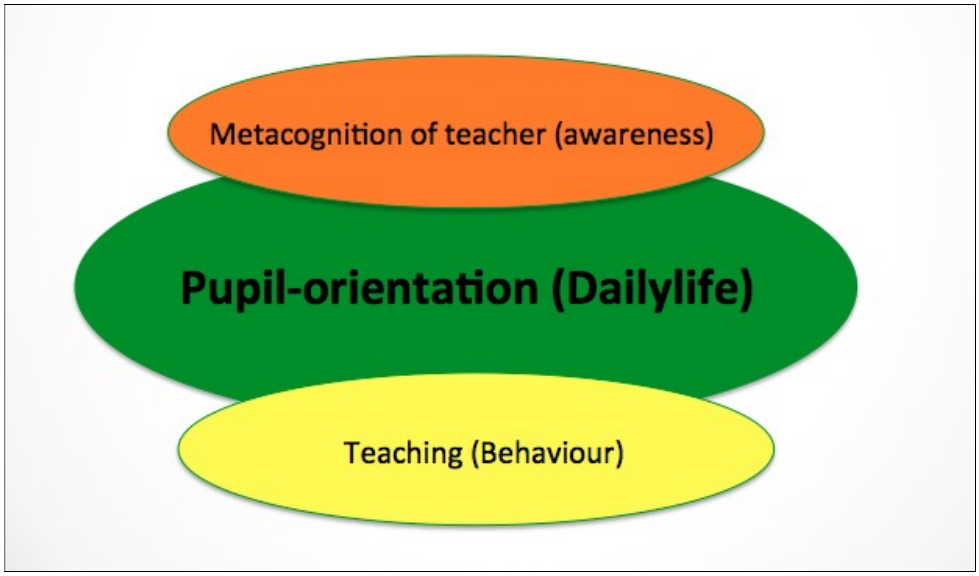
- *What is soap? Why do we use soap to clean our hands? As an everydaylife experiment it would be possible to clean fatty oily hands with water and then with soap. It could be also possible to use different kinds of dirt or water, different amount of dirt or detergent in order to illustrate the effect. Cleaning textiles would have been also interesting to observe. In the next step as a chemical experiment it could be possible to mix fatty oil with water in a test glass. Adding a drop of detergent to this glass would create an emulsion. This experiment shows the phenomenon how detergents help to mix the two immiscable substances. Pupils ususally see soap as a substance with usage, functions, and specific properties (physical imaginations: destroyed dirt (compare 3.3.)) With this pupils might have the chance to connect their experience with another, a more chemical imagination.*
- *Producing soap bubbles can be used as playful learning impulse in order to problematize one of the most characterizing effect of soap and to thematize other chemical terms. To describe this phenomenon from a scientific perspective it is useful to know about e.g. tensides, micelles, surface tension of water, etc.. Actually the explanation of this phenomena is very complicated, but pupils can try to describe, discuss and test their own theory and imagination.*
- *The third experiment uses unconscious experiences in order to thematize the surface tension. Experiences might be water drops, water on a hot surface, insects walking on water, moistening of textiles. To show pupils this phenomenon it would be possible to let pupils create experiments with everydaylife materials. Our idea was to use the clip of a drinking can as a swimming object. Because of the water tension the clip is able to swim on the surface. One of the characterising effect of soap and detergents in general is to decrease the water tension. As a consequence the clip will sink and go down.*

Pupils can experience surface tension and properties of detergents by themselves and they can try to explain their imaginations.

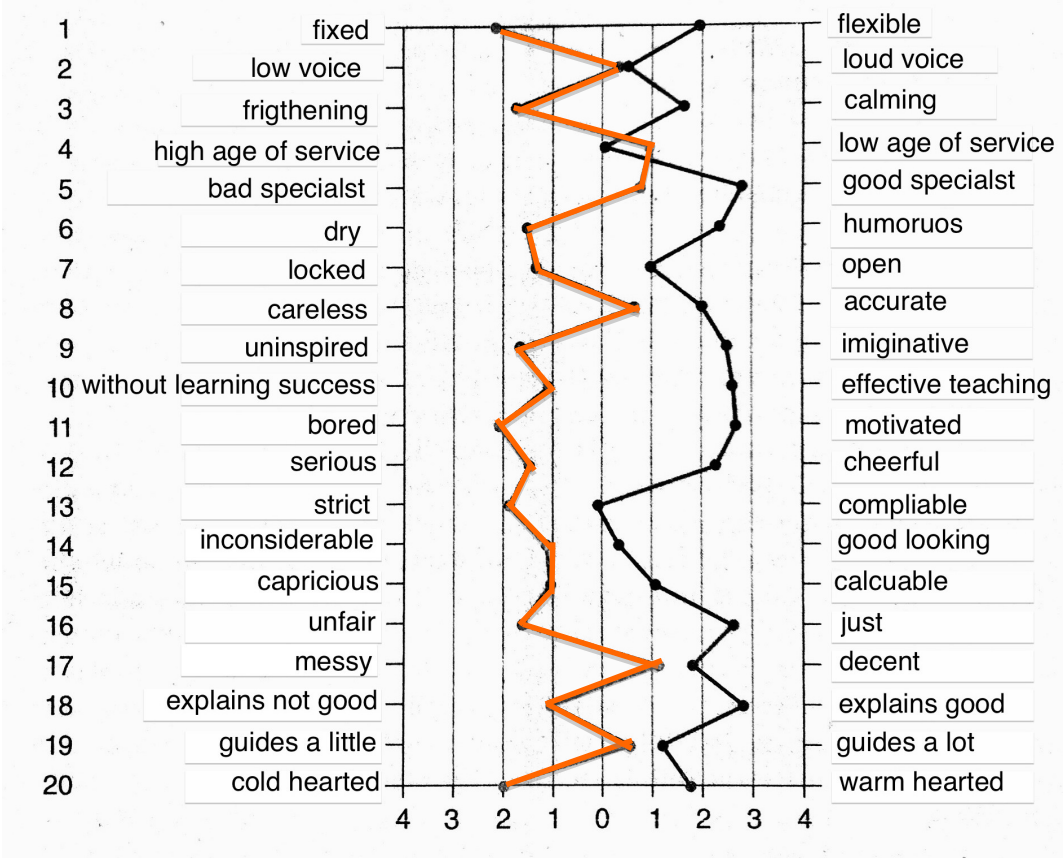
It is also possible to produce soap with the pupils at the end of the soap topic. With this experiment pupils can imitate the production process of soap. They can observe the phenomena, noticing, describing, comparing and interpreting the instrumental experiment. But it is still difficult for pupils to understand the chemical imagination, e.g. of particles of fat, acid fat and the saponification process by this simple experiment. Therefore these difficulties should be thematized and be considered while preparing and teaching.

4. Our message and impression

We have tried to handle the old ancient question from an other perspective. For us an important answer is to regard the pupil more. This is our message. The possibilities to motivate and attract people for chemistry can be very simple and not necessarily complicated as we have shown. A good chemistry teacher must find paths in order to make chemical terms understandable for pupils. Therefore the everydaylife context have a great potential to do so.



Img.5: Awareness for a pupil orientated teaching



Attachment: Polarity profile (The red/black profile of an unpopular/popular chemistry teacher)

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