

# Abduction, Induction and Deduction in Pedagogics

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"How will you look for it, Socrates, when you do not know at all what it is? How will you aim to search for something you do not know at all? If you should meet with it, how will you know that this is the thing that you did not know?"

In Plato's "Menon" (428 – 348 B.C.) Socrates and Menon discuss whether it is possible to define the concept of "good". There is more in Menon's objection than just a clarification of good. It is a philosophical problem. How can we examine something which we do not know about? Which of the things that we do not know about should we suggest as the object for the examination? Even if we stumble upon the object, how would we know that it is what we were looking for, and what we did not yet know? This paradox is known as Menon's paradox.<sup>1</sup>

Out of this paradox emerges another paradox which we know as the paradox of learning. One wonders how a new discovery is reached when it is qualitatively different to the discovery we already have. How can we look for new knowledge, when we do not know what we are looking for? Either we already know what we are looking for – and in that case it (the discovery) is not new, or we do not know what we are looking for – and then it may seem useless to look for what we do not

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<sup>1</sup> Paavola, 2001.

know exists. The paradox builds on the fact that we find it difficult to explain how new knowledge emerges that cannot directly be drawn from previous knowledge.<sup>2</sup>

There are problems which can only be solved when we approach them in a qualitatively new way. Our former strategies do not suffice. We turn over the matter in our minds without getting any closer to a possible solution because the solution is to be found outside the line of thought we normally employ for that kind of problem. We get frustrated and leave the problem alone. And then a strange thing happens – maybe later in the day while doing the dishes, – a clue comes to our mind. An impulse pops up. It may be a possible solution to the problem or a deeper understanding of it. Or it may happen, that the solution turns out being a fruitless attempt, leading to a dead end. That happens. Nevertheless, once in a while, we suddenly succeed in grasping a problem in a new way. Not only can we see our problem in a new light but we also see our old strategy of trying to understand it. We catch sight of our former approach. The question then is, where did that impulse actually come from? Why did the idea not turn up until we let go of the attempt to force us through a solution?

### **Induction, deduction and abduction**

The American philosopher, mathematician and logician C. S. Peirce (1839 – 1914) attempted to describe this process. Peirce believed that so far the concepts of logic had been insufficient to understand qualitative shifts in our thinking. Qualitatively new knowledge is not only a matter of reprocessing the knowledge we already have. The new cannot always be deduced from what we know beforehand. Nor can it come solely through induction, from data and observations we have already done. There must be a third way. Peirce raised objections to the idea that there were only two different kinds of logical arguments – induction and deduction - because he thought there was a third link missing. That is the link that can lead to the creation of new ideas. Creative ideas are born neither through deduction nor through induction. According to Peirce they emerge through abduction.

Induction means to move from incidents to some superior rules or structures through generalisation. The inductive method is to reach a conclusion or a summary of understanding through examples or observation. It could be for instance an observation that all the blackbirds observed within a certain period of time were black. Thus one could be tempted to conclude that all blackbirds are black. (This is actually not always the case, as albino blackbirds do exist.) Induction is a method by which one attempts to reach general knowledge by summarizing observations of occasional incidents or phenomena.

Deduction goes in the opposite direction. With some certainty it predicts a result by moving from rule to incident and from there to the following result. A deductive method is an approach where conclusions are drawn from general laws, theories or hypotheses. If for instance we say that all planets move in ellipses and we then discover a new planet, we must presume that this moves in an ellipse,

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<sup>2</sup> Beraiter, 1985; Fodor, 1980.

too. Peirce thought that through induction we happen to classify knowledge while through deduction we go from already assumed knowledge to a conclusion as to its consequences.

According to Peirce abduction is the third step in scientific thinking. It is the step where a hypothesis is created which could possibly contribute to new understanding. Peirce admitted there was also another word for the concept of abduction: *guessing*. We often guess – right as well as wrong. Nevertheless Peirce believes that from a statistical point of view it is remarkable how often guessing brings us closer to a possible solution, when we are facing a problem. Often through extreme hypotheses scientists come up with new knowledge which, strangely enough, in its form eventually turns out to be quite logical.

When children learn they enter a world of experimenting. They try out new ideas and hypothesis to figure out how to understand the world they are part of. The child moves into unexplored territory. The process is flowing, alive – and uncertain. The child experiments and tests some of the different ideas it comes up with on its way. Creations of hypotheses can also be of a more subtle nature. A painting can be an attempt to express certain thoughts or emotions. Some body movements can seek to catch a certain expression. A geometrical pattern on a nail board can be some pupils' abductive response to a challenge initiated by the teacher. Abductive learning is a matter of constructing possible answers to a given challenge.

It used to be common to distinguish between the inductive and the deductive principle in education. Through history the inductive and deductive teaching principles have been regarded as contrary to each other rather than seen as supplementary ways of teaching. The former Danish professor Thyge Winther-Jensen has previously discussed this problem. He believes that the result of the difference between the inductive and deductive teaching principles often resulted in a division between appropriate and inappropriate teaching. Winther-Jensen writes:

"The deductive methods have been accused of being pacifying, mimicking, authoritarian, indoctrinating, restrictive, teacher-centred – even with social imbalance. On the other hand the inductive methods have been praised for being activating, consciousness-raising, pupil-centred, motivating, etc."<sup>3</sup>

Winther-Jensen does not believe there is empirical evidence to support these accusations. The qualities mentioned are not inherent qualities of the deductive and inductive principle, but adjectives created by different pedagogical trends.

In my opinion the two-part model (the division between inductive and deductive teaching) has suffered from two fundamental disadvantages. First of all, it has developed into a question of 'either – or'. The inductive teaching initiatives have been described as contemporary and relevant methods, and the deductive initiatives have been considered out-dated and inappropriate. Thus the concepts

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<sup>3</sup> Winther-Jensen, 1976, pg. 15.

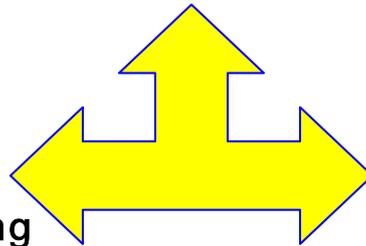
lost their analytical value. Instead of being applied to analyse different aspects of teaching they ended up being used as labels of good and less good teaching. The second reason is that this division into two parts does not consider the fact that we often develop knowledge by guessing or sensing a certain connection. That is precisely Pierces reason for creating the concept of abduction.

In the following three-part model I have briefly outlined some headings for abductive, deductive and inductive teaching and learning methods respectively. In this model the categories may seem to be contrary to each other. But it is important to notice that these categories often interweave and sometimes overlap. Often they are a precondition of each other. Learning and teaching sequences are often composed of several different elements. However, it is appropriate to create conceptual distinctions between its elements. I am not suggesting that the inductive, deductive and abductive elements of the teaching and learning processes are to be seen as separate from each other, but that we can more easily understand them by temporarily separating them. This makes it possible for us to see the dynamic relationship they form. The three part model becomes a tool for the teacher to analyse and identify different aspects of planning teaching. Compared to the former two- part model it is less instructive. It does not fundamentally rank the abductive way of thinking higher than the deductive or the inductive way. On the contrary it points to the fact that often all three elements are present in a teaching situation. Abductive thinking will become blind guessing without deductive considerations and an inductive gathering of information.

## MODEL - abductive, deductive and inductive learning and teaching.

### Abductive learning

Teaching and learning based upon the principle that the learner himself comes up with hypotheses, interpretations or models of problem solving as possible solutions to a certain problem, challenge or proposition.



### Inductive learning

Teaching and learning based upon the principle that the learner draws knowledge and recognition from his own experience. This can happen through past experiences or through experiences and experiments made in a certain learning environment. Conclusions or generalisations are made from the specific experiences to generate knowledge.

### Deductive learning

Teaching and learning based upon the principle that the learner is introduced to a rule, a principle or a theory which attempts to increase his understanding of a certain subject or field. The specific knowledge is drawn from the general rules or principles.

What is the importance of these issues to the practice of teaching ? They certainly make demands on the teacher, because he or she has to create time, space and opportunities in the learning environment for the pupil himself to develop the desire and confidence to create hypotheses that are subsequently examined and tested. It is important to distinguish between using a reduction strategy and a risk-taking strategy. If a pupil tries to avoid what is difficult he uses a reduction strategy. He sticks to what he is fairly sure is right. If on the other hand pupils try to express themselves in creative ways about matters they are not

quite sure about, you can say that they apply a risk-taking strategy. Obviously there will be more mistakes made when a risk-taking strategy is used. In return the advantage is that it challenges the pupils to a greater extent. They experiment with things they are hesitant about and feel insecure with. When applying a reduction strategy you do not make so many mistakes, because you avoid situations and matters that are difficult. If we want to encourage the pupils to come up with hypotheses and guesses to possible problems themselves, there must be a certain amount of freedom for the teacher in his planning to pursue these hypotheses.

Abductive teaching demands that the teacher is given a certain liberty of action. Therefore the teacher's freedom of choice in teaching methods is an important prerequisite. This freedom of choice in teaching methods is necessary, because it gives the teacher the opportunity to pursue some of the themes that emerge along the way in his or her encounter with the pupils in an education period. These themes can be either suggestions from the pupils or ideas that occur to the teacher. In this way the pupil's participation in decision-making is also considered with regard to content. For instance a pupil may suggest that a text can be interpreted from a special perspective. This is an opportunity for the teacher to pick up the theme and examine with the pupil whether the text can be interpreted from that special perspective. This is where differentiation in teaching comes in, too. Because the principle of differentiation employs that teachers should take in consideration the abilities and experiences which each child brings with him. Children are different, and so is their experience in engaging with abductive learning.

Teaching requires that teachers interpret a given context. Factors such as: the basis of the pupils' experience, what time of the day it is, which facilities, tools and materials are available, and which is the most appropriate approach to a given curriculum. A successful teaching period cannot always be transferred from one context to another because the context may differ. This is also the case when considering how much space the abductive elements should play in the classroom. The abductive challenges with which the pupils are confronted may be too open-ended, which can be inappropriate for certain groups of pupils, or they can simply appear to lead to the pupils reproduction of unqualified stereotypes.

An open abductive challenge could be when pupils are asked to write an essay of their choice. There are many possible themes to pursue in an essay. The disadvantage is that the pupils quite naturally write an essay about a subject they know pretty well in a form they are familiar with. Often they are neither especially challenged nor perturbed as regards their own level of attainment. The German sociologist and educator Thomas Ziehe has analysed this problem and he offers a good example: If the teacher plays some suitable, loud music and encourages the pupils to dance as they please it is possible that the pupils will find it amusing. The problem is that very soon they end up reproducing their own body stereotypes. They repeat their own steps again and again. But Ziehe suggests that the teacher asks each child to draw a chalk circle around his or her left foot. After that they

are not allowed to move their left foot from the circle while dancing. The result will be that the pupils are challenged to let go of their former stereotypes and invent new steps. To Ziehe it becomes an example of what he calls a good difference.<sup>4</sup> This is an abductive challenge. The pupils are asked to create an answer to a given challenge. Abductive challenges makes it possible to use new thinking and apply creative ideas. But the use of abductive challenges to the pupils does not on its own guarantee that the thinking really becomes creative. Here the teacher must intervene and consider how precisely a certain challenge can cause a group to reproduce something beyond that of which they already are capable .

Likewise it is necessary to consider to what extent a certain group of pupils can approach abductive challenges. There may be great differences between the groups of pupils being taught. By applying abductive initiatives in teaching the pupils are given a certain amount of freedom in which they can introduce their own thoughts and ideas. For some pupils it may be difficult to tackle the variety of options they are offered because self-discipline is needed to be able to judge critically ones own abductive suggestions or to be attentive to other pupils' ways of tackling a challenge.

Normally an abductive task given to a group of pupils has to be qualified by being followed by deductive or inductive elements. It is the teachers job to ensure this. It is a matter of introducing the pupils to the knowledge, information and skills within the scientific field.

Abductive teaching and learning implies divergent thinking, which means that the mental activity is directed towards different alternatives and new ideas. The answer is not unequivocal and there are several possible solutions. But that does not imply that convergent thinking has no function in learning processes (convergent means that there is only one solution to a problem)? Before the divergent thinking process there may have been teaching based on convergent thinking. The convergent learning process can be the foundation which makes it possible to create divergent thinking. In new scientific thinking Thomas Kuhn expressed the relationship between divergent and convergent thinking in this way:

"...the productive scientist must be a traditionalist who enjoys participating in complicated games with previously set rules, to become a succesful innovator discovering new rules and new instruments for playing the game."<sup>5</sup>

This may sound paradoxical. Kuhn points out that it is necessary to be a traditionalist and innovative simultaneously. An example of that would be the jazz musician who improvises. Precisely by knowing his own instrument and its possibilities completely and by knowing how it was previously used can he try out new ideas. The ability to improvise often implies thorough knowledge of the field in which it happens. Convergent and divergent thinking could be understood as opposites, but in fact they are interrelated and complement each other. It is not a

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<sup>4</sup> Ziehe, 1999.

<sup>5</sup> Kuhn, 1977, pg. 277.

question of one being better than the other because each of them encompasses different dimensions of our ways of discovery. Both have their part to play in learning processes and they cannot be used alone. While deductive and inductive methods are convergent approaches to learning, the abductive method is a divergent approach.

We must be aware of the fact that not all new ideas emerge from linear thinking, because we all know that we sometimes indulge in a certain practice. We submit to something and may not be sure where it will take us. This submission is sometimes a necessary requirement, in the sense that for a few moments in submission we let go of the duality between ourselves and that to which we submit. A merging takes place and like Alice in Wonderland we find ourselves in a new reality. This submissiveness makes it possible to understand contexts from new perspectives. Other dimensions become visible and expose themselves. This is the opening offered by abductive teaching and learning.

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