THE JUGGLERS INHERITANCE
Creativity Training in Design Based Projects

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Abstract

In the middle of the philosophie of CDIO we find the design based project. This is an innovativ, creativ, iterativ and heuristic scan and creation process. The needed creativity has to be formed. The presentation shows some possibilities to form creativity for the design based projects with short creativity exercises. This kind of exercises should be the first part of each design based project.

Keywords: design based projects, creativity training, tacit knowledge

Juggling is easy to learn

The former Austrian car race driver, Niki Lauda, answered the question "your greatest dream": "how wonderful would it be to engraft the treasure of my experiences and my knowledge to my children. Taking a modem, plugging it in and the data easily going on the journey."

We have the suspicion, that learning by plugging is something different than learning from living.

There is another important Austrian philosopher: Karl Popper. Popper expressed the "three world theorie". World 1 is the physical world, world 2 is the world of the psychological phenomenons and the subjective knowledge and world 3 the world of the objective knowledge, written in books. If all of our houses and cities, all machines and tools would be destroyed, Popper wrote, we would be able to reconstruct our world only by reading the books.

I think he fails. I think our intellectual existence is a mixture from knowledge, experience, moral and intuition. And much of this can not be put to a book.

I have an example. The important knowledge for juggling is easy to describe: The juggler starts with two balls in one hand and the third ball in the other
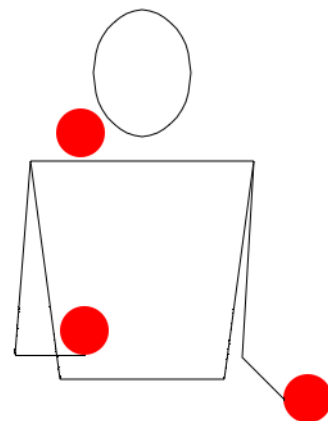
hand. One ball is thrown from the first hand in an arc to the other hand. Before catching this ball the juggler must throw the ball in the receiving hand, in a similar arc, to the first hand. The pattern continues in this manner with each hand in turn throwing one ball and catching another.

The arc and the speed can be defined by formulas.

With a flight time *t* and the launch speed *v is*:

$$t = 2\frac{v}{g}$$

The ceiling *s* of each object is:

$$s = \frac{v^2}{2g}$$

following

$$v = \sqrt{2sg} \text{ and } f = 2\frac{\sqrt{2sg}}{ng} = \frac{2}{n}\sqrt{\frac{2s}{g}}$$

In conclusion: the hight of the pitch has to be equivalent to the root of the number of flight objects. If you attend to this, you are able to juggle with an equal pitch frequency.

You seem to be astonished. Is it so easy to juggle?

Try it, make your own experiments. I suppose, you will flop. It seems your competence is not complete yet.

Explicit versus Implicit Knowledge

This is the way most of us teach in our universities. OK, for some, perhaps many sets of competencies is it the right method, to tell the students facts, formulas and instruments. If I want to teach Statics to my students, it will be successful if I give them knowledge. But even when it comes to Mathematics: Isn´t that more than formulas? Doesn ´t it take a lot of intuition, experience to become a math master?

Nobody can learn juggling by reading or hearing the instructions. We all know that there is another kind of cognition and that both competencies have to be united, before we can talk about connoisseurship (expertship).

And we teachers teach our students only the simple way of knowledge transfer, we hope, while telling our students how to do, they will learn to do.

Our philosophy of didactics is based on the MINT Paradigma: all action has to be controlled by Knowledge and all knowledge is relevant for the practise. We develop deepest respect to the discursive thinking. We hope the human beings become better by reflection.

It is surprising. The science of knowledge and learning has known for a long time that we have explicit, reflexive knowledge (the intellectuality) and the implicit, intuitive knowledge (the Intuition). Only both together can produce experts, adepts. In the realisation of teaching this perception plays an inferior role. As I wrote some lines above: we are coined by the action theoretic paradigma. Tacit knowledge or knowing in action is for us rubbishy knowledge.

For the CDIO Initiative it seems to be extremely important to realise, that proficiency needs both: explicit and implicit knowledge. Our goal is not only to educate those who only have knowledge, we need masters, experts. It is a consequent way, that we had adjusted design based projects in the center of the studies.

What do we want to achieve with this decision? The reason for the focus located at the design based projects is: Our students should learn to handle their subjects with creativity, they shall be able to be inventiv, they shall know, that also in engineering environments iterative methods are useful, that other methods than formula based sometimes are more helpful.

They must realize, that one of the tasks during the studies is creative design.

In technical contexts designing is the process of inventing and coining forms, parts and details of a system and/or function. Esthetic, economic and scientific aspects play an important role. Design plays a role in those aspects of human life in which creativity and planning are close connected.

Creativity is the ability of inventively thinking and acting. Creativity is based on the ability of the human brain, to fill out the gap between situations with unreasonable or with illogical references. Our brain constitutes a meaning by associating the unknown with known situations and playfully theory formation.

We have to work out the differences between the engineering methods and the creative methods. Engineering methods are deductive, they are reasoning from the general to the specific. We have rules and formulas. We resolve a problem by adopting the rules. We only have one or a very few solutions, the result always is right or wrong. Engineering methods are based on explicit knowledge.

Creative methods are inductive. They are reasoning from the specific to the general. We have to solve a problem but we do not have rules or formulas, we have only our experience and method knowledge. Our solution is iterative, that means by trial and error. Somewhen we cancel this process of approaching because we decide that our problem is solved. We do not have an objectively right solution only a subjective one. Many solutions are possible. Creative methods are based on implicit knowledge.

Invention is an operation that needs an outstanding set of explicit knowledge and engineering methods – of course. But without implicit capability, intuition, creative methods the students will not be successful. Our job is to set the basement for both.

Creativity Training

What can we learn from the juggler? What is his heritage?

My opinion is, that we can not demand systematic good results in design based projects without knowing, that

- we have to understand the impact of the explicit and the implicit knowledge for expertship.

- we have to be masters in both worlds

- we have to clarify the relevance of both paradigms to the students and we have to give them the chance to understand this by practicing

It is a long way to this point. We in the University Wismar have a little bit of experience: In some studies in Wismar the engineer students learn creativity before they begin with the design based projects, sometimes more, sometimes less, sometimes a whole semester, sometimes only the first week of the semester. We give them short invention exercises and they have to find an innovative - inventive solution in engineering and design.

Last year they had to invent an innovative seating accommodation. The surrounding conditions:

- innovative (never seen before)

- engineering effort (high technical impact)

- design power (beautiful and functional)

- readymade (redefining objects)

The presentation will show some wonderful and surprising results.