TOYS TO THINK WITH
Constructivism - Lego - Constructionism

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In the course of 1998, the toy company, Lego, announced that they had developed Lego bricks with implanted computer chips that enable them to "sense" and "communicate" with each other when children build them into robots. These robots can then be programmed to carry out certain activities. The theory that children learn something – achieve cognitive development – through manual construction in their play has been labelled 'constructionism'. What does this entail? Can it tell us anything fundamental about how children learn while they play? Does it reveal anything new about the general processes involved when people *experiment* their way towards new insights? What is the difference between constructivism and constructionism?

The first time I saw the term 'constructionism' in a Lego pamphlet I was sceptical. A misunderstanding, I thought, maybe a misprint.

But swapping the 'v' in constructivism for 'on' is no misprint. Contructionism builds on, is a development of, or offshoot of, if you will, the constructivist idea. Whether it is an expansion or a constriction is a moot point!
The idea of constructivism is basically universal, and not confined to science subjects. It addresses teaching in all subjects. The idea of constructionism seems closely tied to playing with Lego bricks, which are undeniably very widespread.

The man behind the word is Professor Seymour Papert, researcher at MIT (Massachusetts Institute of Technology). Working for some years with Piaget, Papert has seen the shift in the concept of human cognitive development that has led to the constructivist theory of cognition.
The Norwegian website

http://hugin.hsh.no/prosjekt/studaktivlaering/index.htm

gives a clear view of the historical development of constructivist learning theory, and describes a project aiming to draw pedagogical consequences of constructivism in the education of teachers.

The idea of constructivism is, briefly, that the individual actively builds his or her own conceptual structures, filling them with knowledge acquired in the process of contextual fact-finding. Teachers assist pupils in this work, rather than pouring fertilisers on barren fields. There is too much wash-out!
Constructivist ideas harmonise beautifully with the principles of differentiated teaching — if we were given a chance to practice them. Slogans like "responsibility for your own learning" have been mentioned in this context, often interpreted as "go as you please and devil take the hindmost."
Constructivism has a social element, in that conceptual structures imply relevant language frames, which can only be developed in interaction with others.

Does it all happen automatically, then, as long as you play with Lego? What actually happens when you play with Lego? What is the great appeal of Lego bricks? Do they assist in the learning process, or are they just for fun?
I must admit that it is this new factor, that Lego with Seymour Papert's help have developed a new generation of Lego bricks with built-in microchips and sensors, that has awakened my interest. Now the bricks can "talk to each other" when they are assembled. Children can build and run robots and learn – but what do they learn?

The theory is that people learn a problem-solving strategy or learning strategy by building, through trial-and-error experimentation, a mechanism that actually works, based purely on their own thought processes. Success in the manual construction promotes thought structures. This may explain the popularity of Lego bricks. Their form challenge the intellect. But what is the challenge?

A Lego brick is a unit with an inherent characteristic: It fits other Lego bricks. If you have enough Lego bricks you can build a wall. Enough walls, and you have a house. You can build many different houses, and the many different houses can make up a town. Spread your towns over an area and you have a landscape: Legoland. Legoland is a simulated reality, and this is part of its quality. Another is the actual process of building the model.

At the same time, this is a model of the fractal composition of the natural universe. This composition is also found in the mineral and biological spheres. The simplest building-bricks – quarks – combine in atoms and molecules, which again combine in more complex structures. Biological characteristics are built into the DNA molecule. The increased complexity seems to offer increased variation, and variation, in the world we know, seems to apply itself to different functions and roles within the totality. We ourselves, in all our complexity, are living examples of this.

It is therefore tempting to conclude that the software packed into our skulls learns – grows and develops – according to the same fractal principles. On the basis of congenital characteristics, the individual is capable, via interaction with the environment, physical as well as human - of developing conceptual structures complete with consciousness, increasing knowledge, options for action and language. The idea that we ourselves can have an influence on and responsibility for the building of these structures is what we call constructivism.

How this was further developed into constructionism is a longer tale. Papert invented a computer language called LOGO so that children could learn to steer a mobile unit called a Turtle. Most maths teachers, at least, have heard of this. In one of his first books, Mindstorms, Papert writes that his idea was inspired by gear systems. Each stage of complexity overlays the preceding step, and none of the steps is dispensable.

With a very small vocabulary – forward, back, turn right, turn left, fly, crawl, etc – the ant on the screen or the turtle on the floor can be steered. The resultant pattern is a drawing of the movements made by the unit under command. Did the unit do what you had intended it should? Did it do what you said? Did you say what you meant to? Time and time again the unit acts differently to what you thought you had commanded it to do. You have to rethink and rephrase your command until the physical consequence of the given command fits with the intention. Just as you can adjust your appearance and comb your hair in front of a mirror until the image fits with your ideal, then the

interior locks and curls in your thought-set can be evaluated and adjusted in confrontation with the consequences of these thoughts converted into reality.

Piaget describes the best self-regulating process as 'the adaptation model', the alternation between assimilation and accommodation. This is the process Lego bricks encourage, too.
Papert's idea and the extension of constructivism to constructionism is to be taken quite literally. Constructing things manually with Lego bricks trains the same mechanisms and strategies used to build conceptual structures in the brain.
Lego bricks are at one with nature – natural structures on the one hand and natural thought processes on the other.

I hope that this clarifies the analogies and that a synthesis is possible, even though Seymour Papert and Kirk Kristiansen, who began from such widely disparate starting points, never knew each other.

Seymour Papert writes:
"We are developing constructionism as a theory of learning and a strategy for education. Constructionism is based on two different senses of construction. It is grounded in the idea that people learn by actively constructing new knowledge, not by having information poured into their heads. Moreover, constructionism asserts that people learn with particular effectiveness when they are engaged in constructing personally meaningful artifacts (such as computer programs, animations or robots.)"

This has now led to the development of the new generation of Lego bricks with built-in sensors for sound, light, heat etc and microchips. The bricks have been assigned information-technological properties which render them capable of a degree of self-regulation. Besides fitting together in a static model, they can be controlled in action.

Read more about all this – I recommend you to pay Seymour Papert a visit on the internet. His address is:

http://www.media.mit.edu

Click on Research, then Epistemology and Learning. The first Lego bricks appear here.
Choose Projects and read about Constructionism and Toys to Think With.
Choose Members and visit Seymour Papert himself. Read here about his new book The Connected Family: Bridging the Digital Generation Gap, and participate in the debate. Here you can click on MaMaMedia. The last two links have also direct addresses:
http://www.ConnectedFamiily.com
http://www.mamamedia.com

Seymour Papert was in Denmark in October 1998 in connection with the Global Learning conference, at which
Danish Colleges of Education were well represented.

Translated from Danish by Rod Sinclair