The role of the computer and CAD tools in research and teaching

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OUTLINE

- Introduction
- Good and bad of past times
- Role of computer and CAD tools
- Learning process
- Therefore: what is the role of CAD tools?
First transistor; Bell Laboratories, December 16, 1947. William Shockley (seated), John Bardeen (left) and Walter Brattain (right).

First Integrated Circuit
Jack Kilby, Texas Instruments, Dallas, 1958
Electronics evolved very rapidly. After a couple of generations electronics now pervades the life of everybody, aids every daily activity.

The rapid grown causes a conflict between generations.
Using electronics and CAD is not difficult:

Electronic devices and CAD are (and must be) user friendly. Moreover, users are accustomed to push a button and to see the result.
Introduction

User presumes that there is no need to read instruction manuals,
no need to know what is inside,
No need to know what are the theoretical basis governing the CAD and the electronic system.

The computer and CAD tools are black boxes.

User wants to see results immediately, to reach high efficiency and to secure a quick turn-around.
Good and bad of past times

The first computers

Many armchairs
Air conditioned
No good storing media
Low speed
Lot of power consumption
Little computation power
Difficult languages

.....
The simulation flow

Write a program in a given language (Fortran, …)

Punched cards with 80 column and 12 rows (hope that the code was printed in the top of the card)

Put the card in the right sequence

Walk to the computer center

Wait and hope …
Good and bad of past times

Do you like using this new strange tool: ... computer?

Well, ... Not bad!

Why?

I can sleep a bit.

Indeed the waiting time was not for taking a nap but for:

• rethinking to the program and to its improvement
• discovering error well in advance and ... be frustrated and disappointed
• interpreting results of the previous simulation or predicting the new ones
• walking back and forth to the computer center
• relax and drink a coffee ...
Good and bad of past times

THE GOOD THING

TO LEARN AND BE CREATIVE
PREPARATION
FRUSTRATION
INCUBATION
INSIGHT
WORKING OUT

MAKE MISTAKES
TO LEARN

MARITAL IS THE MOST EXPENSIVE WAY OF LEARNING YOUR OWN FAULTS
Role of Computer and CAD

What is the role of computer and CAD?

The answer depends if it comes from

- a manager,
- an expert designer,
- a novice,
- a researcher,
- an educator,
- a Ph.D. student.
Role of Computer and CAD

Are an answer to needs

Self actualization

Esteem and self-esteem

Affiliation, Social

Safety, Security

Physiological

IMS University of Pavia
The manager loves very fast computers that are cheap, able to check carefully everything, to bring the risk to zero, to find the optimal solution automatically, that don’t create doubts, that provide certainly, that enable quick designs at low cost, don’t rest, don’t ask for higher salary…
Role of Computer and CAD

An expert designer

Self actualization

Corresponding to the human needs:
Find answer to curiosity
Discover new things
Create beauty

The expert designer is like an artist. She/is difficult to manage. Money is not enough, even if money matter.
Computer and CAD can be enemies if they answers don’t fit the expectation.
Computer and CAD are friends if they confirm or help in refining ideas.
Computer and CAD are enemies if they do what is enjoyable.
The human need are for:
- Safety
- Reduce the stress

The novice needs help and guidance. Often trivial problems stuck the activity. Uncertainty and fear are source of stress and block personal capabilities.
Role of Computer and CAD

The human needs are:
- Playfulness
- Creativity

A researcher

For a researcher CAD tools are for verifying new ideas, for a non conventional use and for stimulating the creative process.

Also, CAD is for avoiding boring steps of the research activity.
Role of Computer and CAD

An educator

The human needs are:
Knowledge transfer
Social contributions

For an educator CAD tools are for favoring the learning process, to enable a virtual experimental lab, to help in retaining knowledge.

Speed of CAD tools is not a good feature. (it should match the speed of brain)
Role of Computer and CAD

Needs a safe future

A PhD student
The human needs are:
Learn, enjoy
Adventure
What managers and production expect?

To be assured that everything will be OK

To recheck and recheck

To avoid to think hard

To fix problems caused by flaws

To have a good and patient slave

To do things very quickly
What a teacher and a student expect?

To transform a “potential” expert into a scientist or an engineer able to handle complexity.
What a researcher expects?

To have support in the creative phase and to verify crazy ideas.

To be recognized as a good inventor or a good technician, and to obtain money and glory.
Learning process

The complex mechanism of learning a new subject is the mix of five key features:

Learning as memorizing, storing simple information to be reproduced without significant changes.

Learning as a quantitative increase in knowledge, just collecting information.

Learning as acquiring skills and methods, retained as background.

Learning as making sense or abstracting meaning.

Learning as interpreting and understanding facts in a different way, which involves comprehending the world by reinterpreting knowledge.
There is a substantial difference in quality (and difficulty) between these five features that we can summarize in “knowing that” or “knowing how”.

Obviously, the aim of teachers and researchers is toward the more difficult “knowing how” but a bit of “knowing that” is necessary because it provides news and practical details and also helps in contextualizing study and avoiding too much abstractions.

**Therefore, ...**

For what the computer and CAD are beneficial?
If we hear, we forget; if we see, we remember; if we do, we understand.
Learning process

Computer and CAD tools for:

becoming accustomed to uncertainty and inaccuracy, by the use of example and computer simulations.

The expected profits gained are:

- to beat incredulity
- understand limits of approximation
- reinforce knowledge
- learn rules of thumb
Therefore, what is the role … ?

To make life easier?

NO!
Therefore, what is the role … ?

To change human habits?
Therefore, what is the role ...

To create (false) added value?
Therefore, what is the role … ?

To reduce stress?

\[\text{STRESS IS THE DISEASE, CHOCOLATE IS THE CURE}\]

\text{NO!}
Therefore, what is the role ... ?

I think that your answered NO!

Because ...
Therefore, what is the role …?

**Computer and CAD tools are for**

*Using the brain*

and not hands!
The End