How to teach engineers that are students yet?
It is a crucial question for our civilization today:
How to account for the facts
- today’s youth has not been a fan of mathematics and physics like it was in 1900-1970;
- they are fans of computers and the Internet, and often know them better as teachers.
We find the above are key stones to proper education methodology.
- Why do we emphasize “Engineers” in the course title? Because they need quite different, “Programming” with regard to “programmers”, with more Mathematics and Physics, with more Algorithms.
- Dualing with modern newcomers, we need sometimes to re-switch students from music, TV and Internet to serious technologies;
- We apply methodology of “Own student Discoveries” [1,2].
- The proper way to realize “Own Discoveries” is an Easy Programming;
- There is a number of programming languages. Today’s student learn Delphi, C, C++, Java, Python etc. Indeed, they are valuable for students to become a programmer but not an Engineer. To educate Engineers we suggest a wide use of modern mathematical packages, particularly MATLAB, that are the only to lead to “Own student Discoveries” [1,2].

In this poster we demonstrate how we realized our educational approach in Aerospace Control Systems Department of National Aviation University (Kyiv, Ukraine).

Easy Programming is the way to everything! - 1 -

Method of “Own student Discoveries”
Education is rather conservative field about 2000 years old. Lectures, one of its main instruments, is a passive one. Laboratory and practical works have somewhat active; however, students often execute them “automatically” without bearing in mind the question “Why is it so?”. Cinema and TV allow us see many uncommon things by own eyes today, but it is a passive method as well. Computer technologies significantly extended what students could try and test in their Laboratory Works. Most of students, however, fizzle to really hands asking “Why is it so?”.

“If is it so?” means that the student should repeat original discovery in the field and understand its origin. They will not require 300 years for this, or several months, or even a week – a PC-environment should help to get result in hours or even in seconds. This is what we mean under “Education by own discoveries”.

The British genius Stephen Wolfram suggested revolutionary to learn each science through programming cellular automata [3]. Our approach is more conservative and practical: to dictate one and half first years of teaching to an Easy Programming, to create a few own educational programs, and then systematically apply it in almost all Curriculum disciplines.

We invest two semesters of the First teaching year to get students familiar with MATLAB as an Easy Programming environment. The third semester is devoted to object-oriented language Java. We try to start “own discoveries” as soon as possible. Our time plan lies in the following (4.5):

1. ABC of the MATLAB, use its visualization capabilities to “discovery empirically” how the polynomial sequence

\[ (1 + 1) \times 1, \quad (1 + 1) \times 2, \quad (2 + 1) \times 1, \quad (2 + 1) \times 2, \quad \ldots \]

tends to the function \( f(x) = x^2 \) and another

\[ \frac{1}{2} \times 1, \quad \frac{1}{2} \times \pi, \quad \frac{1}{2} \times 2, \quad \frac{1}{2} \times 3, \quad \ldots \]

2. Philosophical difference between analytical and numerical actions like

\[ \int_{-\infty}^{\infty} e^{-x^2} \, dx = \sqrt{\pi} \quad \text{(analytical and geometrical getting derivative and integral)} \]

3. Idea of Algorithms; start programming in MATLAB.

4. First (simple) own “Discoveries” lead by Instructor: finding experimentally; shutting stone over surface; probability.

5. Approach in Aerospace Control Systems Department of a Nigon, plotting and rotation of N-pointed star, a Propeller.


7. Simple use of sound and image.

8. Complex data types, polymorphism in MATLAB programs.


10. Graphical User Interface.


12. Term Paper on student choice to realize her/his own project. Some programs made by students are displayed below.

The third semester is usually devoted to Java and to OOP properties of MATLAB. It includes similar problems, approaches and algorithms. It ends with Term Paper as well.
Programming abilities gathered students apply to other disciplines studied in subsequent study years, see below.

Conclusion
Programming governs the World of Education. [3]. Why not to use MATLAB?
Easy Programming in education of Engineers?
- With MATLAB, we realize methodology of “Student Own Discoveries” [4-10].
- This corresponds to best World methodology suggestions [3,11,12] etc.
- We should save student’s curiosity and “shining eyes” till the end of education.

References
2. Gayev Ye., Azarskov V. Educational “Own Discoveries” Method by an easy MATLAB-Programming for Engineers. In: CAA 2018, 3rd - 5th October | Vicenza, Italy

We present an innovative educational course of “Programming for Engineers” here that realizes own student’s discoveries in science.

We get first year students with “shiny eyes”. Our education aims to keep their shining till the 6th year.

More details see in neighboring poster.

Easy Programming is the way to happy student’s Discoveries!