The saber-tooth curriculum-part two

(electro-magnetics and power electronics professional "dream education")

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***Abstract*—Education outcome is very important for practical work in industry, design, research as well for lifelong education and theoretical work. Article deals with some aspects of all-around world discussion on education content, process and education meaning from society point of view.**

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I. INTRODUCTION

On 1939. T. Abner Peddiwell publish a satire curriculum "The saber-tooth curriculum" [1].

It tells the story of a prehistoric tribe witch decided to introduce systematic education for its children. The curriculum was specially designed to meet particular survival needs in the local environment and so included such subjects as saber-tooth-tiger-scaring with fire. But the climate at the region changes and the saber-tooth tigers perish. Attempts to change the curriculum to meet new survival needs encounter stern opposition.

Arguments against the change - very common idea nowadays - was:

"we don't teach fish-grabbing to grab fish; we teach it to develop a generalised agility with can never be developed by mere training,"

"we don't teach horse clubbing to club horses; we teach it to develop a generalised strength in learner with he den never get from so prosaic and specialised a thing as antelope-snare-setting,"

"we don't teach tiger-scaring to scare tigers; we teach it for the purpose of giving that noble courage which carries over into all that affairs of life and which can never overcome from so base an activity as bear-killing."

And final argument say all about rock-solid education content at all:

"if you had any education at all you would know that the essence of true education is timelessness. It is something that endures through changing conditions like a solid rock standing squarely and firmly in the middle of a raging torrent. You must know that there are some eternal verities, and the saber-tooth curriculum is one of them."

So - what happen during last century in electro-magnetics and during last decades in power electronics professional education process and content.

Below author describe his thoughts, opinion and point of view about this topic - "The saber-tooth curriculum. Part two".

Authors opinion is based on more than 45 years of professional experience in automatics, power electronics, process control, communication tools, automatic regulation, MCU and web code compose, data base design etc. About 260 personally or in small 2-3 people team developed and implemented projects from scratch, different size and complexity. About 80% of projects involve research and engineering side.

II. UNIVERSITY TYPES, EDUCATION CONTEXT AND QUALITY

A. University types

We still can recognise "Humboldt type university" and "anglo-saxon type university" in spite of current classification attempts as 1st, 2nd and 3rd generation of universities.

"Humboldt type university" (mainly Europe) in general reflect as an ancient collegiate university offering traditional academic courses, provide research and have a large number of students, graduates and many overseas students in some cases. Not very friendly to the practical side of the technical "life".

"Anglo-saxon type university" (mainly America) in general is locally-orientated university which does little research and offers more vocational courses to a higher percentage of students from the local area. Not very friendly to the theoretical side of the technical "life".

Today all is messed up and it isn't possible clearly define university type. More popular is to postulate university role in to society - to be "a centre of cultural, educational and research for society". Like every city park or zoo do. Reason — globalisation and business tendencies and necessity to attract more students.

B. Education as business or education as knowledge

Education was, is and will be just a business from university point of view despite that universities doesn't agree with such postulate. And like companies "have value on stock market" and are placed on the numbered list accordingly, universities are ranked by different "values", like "number of

Nobel prize winners from graduates" (Nobel prize - pure political decision today) or number of Scopus indexed publications, number of students etc., thus trying to determine their "value" and also are placed on numbered lists.

In both cases there are no any indications about correlation between position on the list and real impact on production or technologies development or students knowledge. In spite to postulates that society become "knowledge society".

It's well known that terms "education", "knowledge" and "skills" aren't the same but all together are covered with term "professional". Professionals provide research or engineer jobs, at least we assume that. Universities (as well as similar institutions) still are dancing around terms "education", "curriculum" and general postulate - "if you don't know this bla,bla,bla… in to the smallest details you cannot become and an engineer or researcher…". Wrong.

In 1940-ies - 1960-ies - 1980-ies you cannot be an engineer or researcher if you haven't study magnetic amplifiers or "drive-generator" systems in to smallest details. Who remember or know magnetic amplifiers or DG systems today? In spite of tons of research papers and filled patents in these topics. Or who remember formulas how to switch from relay based logic circuits to TTL logic circuits? Ok - roots of attempts to build personal computer operating system under small RAM or HD volume (1984 Apple Macintosh include just 40 MB hard-disc, for example) we can still see in Microsoft Windows operating system.

The main argument (if some argument exist at all) to choose study program still is employment or work possibilities afterwards, regardless of any classification of universities. Different activities and techniques take place to enrol more students - to get more money - so typical advertising tools are applied. And advertising tools work time after time, as we know.

Education result in a lot of cases are adequate to advertising: after high school: no experience, no job; achieve Bachelor: no experience, no job; after Master's: no experience, no job; defend PhD: no experience, no job and… unemployment office…Don't agree? Take a look on youth unemployment figures all around the world.

"Chain" Bachelor- Master - PhD in non-stop run is wrong at all. Masters studies must follow after 2-3 years of practical experience and doctoral studies can follow Master's studies after 4-5 years of practical experience from author's point of view. Question or problem is ability to find short therm jobs between studies levels.

Reason for such "chain" is the same as final argument of the saber-tooth curriculum: "the essence of true education is timelessness…, you must know that there are some eternal verities, and the saber-tooth curriculum is one of them.". And fail again.

Education system looks like a swamp where time after time some gas bubble arise or small flower comes out. Currently we relay on swamp in hope to see some flower.

C. "Modern" names and definitions

Study topics and programs pretend to be "new" or "actual" by setting to them a new names, definitions or descriptions.

"Internet of Things" is one example. One can imagine that this is a brand new topic, never used before, something very perspective and definitely must be progressive and offer a lot of free workplaces to find a job.

In essence - "no internet and no things" today, just pure tele-commands, telemetry and distributed automatic process control create a "lion share" of known cases. Just communication methods and tools are different in a bit. Included known areas doesn't offer more free workplaces for graduates. Positive is that name "Internet of Things" is shorter overall name of listed topics in paragraph above, cover wider technical area and in some way consolidate the field we are talking about.

Other topics are all about of "artificial intelligence" [2] and similar stuff. The field was founded on the claim that a central property of humans, intelligence "can be so precisely described that a machine can be made to simulate it."

In spite of the claim that "…it has become an essential part of the technology industry, providing the heavy lifting for many of the most challenging problems in computer science…" and others, there still aren't clear the precise amount of intelligence or intelligence level they are talking about: intelligence of drug user, robber, stock market agent, teacher, librarian, musician, painter etc.

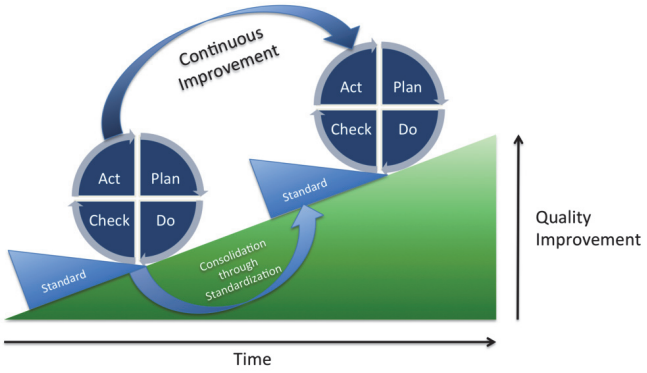

Fig.1. Continuous quality improvement with PDCA

So - or the definition and all research topics are wrong, or the meaning of all this stuff is oriented just to find money for "research". Covering such topic in university education is clear time wasting, from authors pint of view.

Meaningless abracadabra. Meaningless definition. Modern and meaningless topics. Example of the saber-tooth curriculum: "… we don't teach tiger-scaring to scare tigers; we teach it for the purpose of giving that noble courage which carries over into all that affairs of life and which can never overcome from so base an activity as bear-killing.".

D. Education quality

Today are a lot of talks about education quality and possible methods how to evaluate educational process quality.

One of methods are a bit changed W.E.Demming's quality management method - PDCA (Plan–Do–Check–Act or Plan–Do–Check–Adjust). In the first sight this method can be

applied to manage education quality too (Fig.1.). As known, many educational institutions try to use PDCA-like tools to improve education quality. Wrong.

PDCA-like tool can be applied for education process only if care about student gained knowledge and skills doesn't exist, only for "pure education process". "Pure education process" is meaningless set of words and don't cover any process at all. It is description of "saber-tooth curriculum".

In essence PDCA method was developed for "enclosed" environment for defined period of time - production process. Education, regardless of the level, is just a beginning for lifelong learning.

Thus knowledge are accumulated over many years and application of terminated PDCA cycle is meaningless, as mentioned above.

More - there are no way to check (evaluate) knowledge level or amount by education exams, tests etc. or student feedback. Exams and tests allow to check just small particular parts of knowledge due to complexity of "education - knowledge - skills" in full.

There are attempts to evaluate education process by students feedback and make improvements through this. Problematic question - does the education process and students feedback are connected with real "education-knowledge-skills" level at all.

Other missed answer from feedback: if students feedback give poor evaluation of some lecture course there are no answer about next steps - take course again or leave situation as it is - students miss some part of knowledge, typically necessary for following topics.

This question is essential: what if some topic is badly or "no one can understand" explained by tutor? Leave students without knowledge? Push them to take it again? Answer mainly depend from topic importance and university tactics. Here PDCA can't solve problem. Question still is open.

III. Dale's Cone of Experience and Knowledge

Dale's cone of experience [3], [4] (Fig.2.) is actual from author's point of view, if we are talking about technical education [5].

Cone of experience is a try to evaluate correlation between information source/type and persons memory - what one remember after a while. Correlation is very close for graduates as author has observed during practical and professional experience.

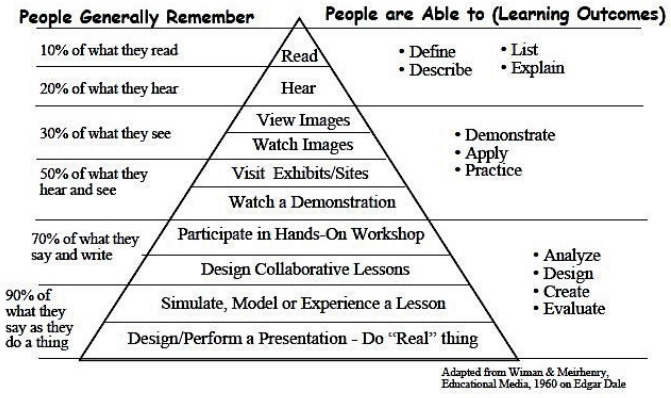

Fig.2. Dale's cone of Experience

After several hours , days or weeks (individually for each person) student's remember:

- 10% of what they read,
- 20% of what they hear,
- 30% of what they see,
- 50% of what they see and hear,
- 70% of what they see and write,
- 90% of what they say as they do a thing.

Unfortunately universities, especially "Humboldt type", in a lot of cases are satisfied with first 50% (Fig.2.). But no one knows which 50% (of presented 100%) auditorium remember.

At some point Dale's cone of experience explain paradox: graduate gain high marks on exams and near zero knowledge after graduation. Some days of intensive educational material study before exam allow to gain high mark and successfully forget all about a day after.

We are living in "information age" or "third wave" of our civilisation" [6]. Today we receive enormous amount of information every minute. It is estimated that a week's worth of the New York Times has more information than a person was likely to come across in person's lifetime in the 18th century England. [7].

Presented study topics are diluted by online news,fun-clubs messages, social portals/communication, pictures and videos upload/download and many other kinds of information.

But the human memory still act as many years ago - to remember, information from our short-term memory must be written in to long-term memory. Under "third wave" only part of information can be re-written to long-term memory because short-term memory is overloaded.

Thus students knowledge become fragmented and non-continuous. Knowledge entropy occurs instead of 'knowledge'" as like know it. Side by side to un-ability to calculate even simple numbers without calculator. Side by side to un-ability to write text as we used to know it by replacing with SMS text-like abbreviations.

IV. Innovation and Creativity

Today very popular word is "innovation". Every piece of equipment, every research, every process etc. today must be "innovative".

Innovation is creativity. So everyone involved in to process must "creative". Good, just small remark - how technical universities help to develop creativity during "The saber-tooth curriculum. Part two"? Definitely nothing.

Electronic etc. engineering curriculum must include some more or less creative topics like drawing, painting, music, theatre or other in order to develop or uncover some of persons creative skills. From author's point of view.

Someone definitely doesn't agree. For opponents author just want to ask "do you have ever design a printed circuit board?" or "have you ever pack electronics in to small volume?". And final question - "are you satisfied with result of your work?"

Imagination and creativity at some point can be activated through knowledge of the history of the topic - from first announcements till now-days.

V. Electronics Engineer Knowledge Base

Not only for electronics engineers. Also for power electronics, communication, power distribution etc. engineers and professionals.

Our world relay on energy - potential, kinetic, electric, thermo, solar and other kinds of energy. Energy saving is a very important matter today and must be in to the centre of all topics.

Good university education, creating knowledge and experience, is a higher level mix of high school education and vocational school education. “Pure theoretical” professional cannot get wide application of his knowledge. Written above allow to make a conclusion: course topics must be based on approx. 50% of theoretical part and approx. 50% of related practical exercises [8], [9].

Knowledge base is well known and simple. Main rules are:

- one must know that only he can create his knowledge, not university or anyone else,
- one must know that knowledge creation is life-long process and university just can guide to start this process, regardless of curriculum,

Basic content are based on (including derivatives):

- understanding of electrical charge, current and circuits,
- understanding magnetics and magnetic circuits,
- understanding of heat and heat processes,
- Ohm’s Law and Kirchhoff’s Laws for electric and magnetic circuits,
- electrical energy sources, energy conversion, electrical power and energy calculations, energy flow,
- RL, RC and RLC circuits, their derivatives and pulse response, filters,
- electronic amplification, switching and rectification elements, devices and circuits,
- relaxation and sin wave oscillators,
- complex signal sin harmonics, their importance and math equations,
- pulse-width modulation,application to mentioned above,
- physical parameters sensors,
- “hard" and fuzzy logic, logic elements and circuits,
- software code logic structure, micro controller coding,
- some additional knowledge,

The next come more complex topics - electrical machines, drives and control, micro controller coding, radio-waves, modulation, signal send/receive, communication means/ protocols etc.

Listed is a many hours long base, the rest (and more advanced) is imagination and creativity - how to solve a question/problem through listed knowledge.

University education start with more basic topics and then involve more complex in to study courses, as a rule. Based on idea that students know and remember pervious courses and topics. Not very true, according to the Dale’s cone.

Options? Good question. There can be two options from author's point of view:

- first - lecturer have a good practical (or industrial) experience related to product development, professional in to the field. In this case then 50% of lecture plus 50% of practical work can be the best for knowledge creation. Knowledge base topics can be repeated easy, if necessary,

Such option will be a part of the electro-magnetics and power electronics professional “dream education”.

- second - we continue to be under “The saber-tooth curriculum”. Just today it is Part two.

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