WIP - Leonardo 21 Project: A New Approach

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Abstract — This research-to-practice WIP paper describes a new educational approach for an engineering under graduation program. The willingness to grow, make difference, and impact the world is in human nature. It is the force that moves humanity ahead always full of hope for the better. Engineering is a career that provides individuals the opportunity to fulfill this objective. For young men, it is the construction and transformation of the world, and for young ladies, it is the opportunity to help people on a larger scale. It has been named "Leonardo 21 Project". It is expected to be implemented in 2025.

Keywords — Teaching method; creative mind; innovation; Renaissance; research.

I. Introduction

This innovative practice WIP paper describes a new educational approach for an engineering under graduation program.

Historically, the importance of engineers for development for the good of humanity has been of great importance, and this trend will only increase over time. Engineering and engineers have had an enormous impact on every aspect of modern life.

The work of engineers is to solve problems, propose theories and models, and transform the theoretical into practical for the improvement of human work.

No country or society today would succeed without engineering at some level. Agriculture, construction, health sectors, and transportation among others. Engineers made the Internet possible opening to the world a floodgate of information unprecedented in the history of humanity. And the list goes on.

Engineering is concerned not only with the knowledge of natural phenomena but also with how knowledge can serve the needs and desires of humanity. Variables such as cost, user compatibility, producibility, security, and adaptability to diverse conditions and external operating environments must be taken into consideration in the design, development, operational support, and maintenance of the products and services that engineers create. Thus, engineering involves the integration of knowledge, techniques, methods, and experiences from various fields [1].

These are some aspects that show the importance of engineering education. Good engineering programs are key factors for the advancement of science and technology and that is why universities invest in providing good engineering programs that also fulfil the requirements of employability and professional advancement.

A private engineering college has challenged the Science and Research Education Organization – COPEC engineering education team to design a program for a new generation of students after the "online education big event" that pushed the adoption on a global scale of this way of communication to work, do business, and study. The Education Research Team of COPEC has designed a course that can be implemented from the second year on. It has been called the Leonardo 21 Project. It is in fact a new method of teaching theory and practice in a steady and scaled way culminating with a big project.

The primary focus of the paper is to show a new method to teach future engineers to do research seriously in order to enrich the problem solve and project development. The goal is to instigating students to develop a new perspective and the perception of other aspects not only about technical aspects but also about history, nature, biology in order to add value and see new ways to develop a project.

II. Work Team

COPEC Education Research Team has a history of courses and programs development for different programs mainly in engineering of programs for private universities.

It has a considerable number of successes taking into account the variety of faculties and university objectives.

The COPEC - Science and Education Research Organization is constituted by scientists of the several areas of human knowledge. Its members have embraced the mission of promoting the development of science and technology; they are all scientists who believe that education is the main beam in the construction of a better society.

It is an organization, which work has the goal to enhance and maintain relations between universities, institutions of education, enterprises, and the society of several countries not only for the discussion of education, technology and sciences directions as well as to propose solutions.

It has a history of more than 20 years of existence. It is a group of scientists, teachers and professionals, whose future vision impelled them for this work, which is growing and solidifying as a weight organization not only nationally as well as internationally [2].

III. Engineering and Renaissance

"Engineering" in the modern sense traces its name back to the Roman era. "Engineer" is based on the Latin word for "ingenuity". Roman engineers built aqueducts and designed heated floors, among their numerous accomplishments. However, engineers built significant structures long before this. For example, engineers designed and built the Aztec and Egyptian pyramids, the Great Wall of China, and the Hanging Gardens of Babylon [3].

The Renaissance refers to the period in European history between the 14th and 17th centuries. As a historical era, the Renaissance was preceded by the Middle Ages and succeeded by the early modern period. Alternatively, the Renaissance is considered more of an intellectual and cultural movement than a historical period. Indeed, today, the Renaissance is commonly thought of as a time when Europe made great advances in the sciences and the arts, as opposed to the Middle Ages. Although the Renaissance is most notably connected with the Italian city-states, as it was there that this movement originated, over time the Renaissance would spread to other parts of Europe as well. The Renaissance was a cultural, scholarly, and socio-political movement that stressed the rediscovery and application of texts and thought from classical antiquity. It brought discoveries in science; new art forms in writing, painting, and sculpture; and state-funded explorations of distant lands [4].

IV. Leonardo Da Vinci

Leonardo Da Vinci (1452-1519) is best known as the artist who created the "Mona Lisa" and "The Last Supper," but he was also a self-taught engineer. This open-minded, inquisitive, boundless, practical dreamer was driven to learn and had a restless mind.

Da Vinci lived in Italy for 67 years during the mid-1400s. In a time far before electricity, when water was used as power, and 100 years before Galileo had worked out measuring time, Da Vinci was an engineer and proficient inventor of both working and theoretical inventions. His artistic talents enabled him to record his mechanical ideas with enough clarity that blueprints for working models could be created, allowing humankind to continue celebrating his achievements in modern days [5].

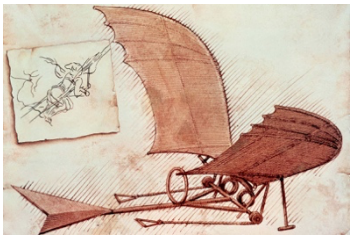

Fig. 1. Flying Machine

"In his Codex on the Flight of Birds, da Vinci discusses the relationship between the center of gravity and the center of lifting pressure on a bird's wing. He explains the behavior of birds as they ascend against the wind, foreshadowing the modern concept of a stall," says Jakab. "He demonstrates a rudimentary understanding of the relationship between a curved wing section and lift. He grasps the concept of air as a fluid, a foundation of the science of aerodynamics. Leonardo makes insightful observations of gliding flight by birds and how they balance themselves with their wings and tail. "He comments on the pilot's position in a potential flying machine and how control could be achieved by shifting the body weight, precisely as the early glider pioneers of the late 19th century would do. He notes the importance of lightweight structures that aircraft would require. In less than 20 pages of notes and drawings, the Codex outlines some observations and beginning concepts that would find a place in the development of a successful airplane in the early 20th century." [6].

It is one of the examples of his meticulous work based on observations of nature and the employment of mathematics. The most crucial aspects of mathematics in engineering involve cost-benefit-risk analysis and the use of mathematical models. Almost all aspects of mathematics can be, and are, applied in some way to the engineering design process. Like all engineering fields, they require advanced knowledge and the ability to properly use many mathematical skills, including but not limited to algebra, calculus, geometry, measurements, tables and graphs of results, mathematical formulas, and timelines. For mechanical engineers, mathematics is crucial to carry out engineering tasks in the planning and design of tools, engines, machines and other equipment that work mechanically [7]. Hence the importance of emphasizing the use of mathematics as a basis for developing projects inspired by the works of Leonardo da Vinci in this course.

V. Methodology

A teaching method is a set of principles and methods used by teachers to enable the student learning process. The applied strategies are determined partly by the subject matter to be taught, partly by the relative expertise of the learners, and partly by constraints caused by the learning environment. It is the interaction between the teacher's knowledge, the student's knowledge, and the subject to be learned [8].

The teaching method proposed for this course is to teach theory and practice in a steady and scaled way culminating with a big engineering creation. Something old and new combined and rooted in serious research with applications and designed to be usable and promoter of development. Therefore, the final result is the designed device, a machine developed by the students based on Leonardo's engineering sketches and ideas with the leadership of the teacher/mentor presented to the academic and industrial community in the fourth year of the program. The course is based on the works of Leonardo Da Vinci, mainly in the area of engineering. The key element and the requirement in the development of the machines is Vitruvius's proportions which influenced Leonardo's work. The Triad speaks of the three qualities that a building must possess, according to Vitruvius. The triad is made up of: – Utilitas – Utility or usefulness, the function; Firmitas – Resistance and durability, the structure; Venustas – Beauty, form. This means that a building must be sustainable, stable, beneficial, and beautiful – a statement that is true even today and must be also applied in any engineering project development [9].

It is undergraduate research allied with practice. The goal is to connect key concepts and questions with students in their early years and active involvement in systematic investigation and research as the basis for their professional performance in working life.

As long as methodology means "a branch of pedagogics dealing with analysis and evaluation of subjects to be taught and of the methods of teaching them" [10], the authors speak about a method that has the starting point the history research about the Leonardo DaVinci's life and projects with the objective to inspire students to design and develop a useful device made with new materials and technology based on Leonardo's designs.

So the method is is more than research but the process of actually make students understand the way DaVinci observed everything around him, and used the information and his

understandings to design something useful. Looking for the optimum solution with the available materials.

There is a step that precedes the implementation of the new course to be integrated into a college's mechanical engineering program. Create the course statute: The objective is to align all stakeholders and team members involved in the main aspects that matter to the program, which are:

- Vision;
- Strategic alignment;
- Scope;
- Goals;
- Metrics and KPIs (key performance indicators);
- Benefits;
- High-level timelines and milestones;
- Resources;
- Risks and problems.

In terms of working effectively with the students in the program:

- the first step is to involve students with actively contested questions, empirical observation, cutting-edge historical technologies, and the sense of excitement that comes from working to answer important questions;
- the second step is to gather enough information about Leonardo Davinci's life, artwork, and sketches in the field of engineering more specifically mechanical devices like cars, flying machines, derrick, and textile machines as well as his work in hydraulic engineering;
- the third and final step is the development of a mechanical device with new materials based on Leonardo's devices with the characteristics of being e useful and usable. It is a challenge that will certainly shape the quality and outcomes of the engineering program.

The effort will demand an investment of some hundred thousand dollars to create a new space, a new room specially designed for the development of this special course. A classroom equipped with the latest technology in classroom communication, lab equipment, desks, materials, technicians, and teachers trained as mentors to inspire and help students make choices and keep them motivated along the process. Despite a homepage designed for all involved teachers and students to exchange ideas, working progress updates, homework theoretical content, etc. The goal is to provide them with an environment that ignites their curiosity and also tools that can boost their interest and willingness to perceive and as well as be committed to a long-term goal.

As the engineering program lasts 5 years, it was decided to offer the course from the second year onwards, when students already have some basic scientific knowledge to delve deeper into research and application of science. The culmination will be the presentation of the student's projects for the academic and industrial community. The goal is to capture the attention of the industrial and services to the engineering program and increase the job offer for future engineers graduating from this university.

VI. Motivation and Creativity

Creativity is described as the result of a complex interaction between a human being and his environment and/or culture. In terms of education, real learning and creativity require student engagement, which involves a combination of motivation, concentration, interest, and pleasure derived from the learning process itself – essential qualities for flow [11].

Truly creative people work for their own work's sake, and if they make a discovery or become famous, they consider it a bonus. What drives them, more than rewards is the desire to find or create order where there was none before.

Genuine creativity can only emerge when people master the medium or domain in which they work. A product or idea that deserves the label 'creative' arises from the synergy of many sources, not just the mind of a single person [12].

There are research projects that have shown that there is a very strong connection between intrinsic motivation – that is, doing something for yourself – and creativity. The greater the intrinsic motivation of the creator, the more creative and original he will be. On the other hand, the more people focus on extrinsic motivation - rewards or punishments for doing well or poorly - the less creative they will be.

It is all about what experiments and research have shown that creativity has to do with two types of motivation: Intrinsic and Extrinsic Motivation, both important being the first one the most important.

As long as it is a pedagogic project to be developed from 2025 on there are no discussions or results yet. However, some results are expected and described in this paper. The goal of this paper is to show a pedagogic proposal to be developed that has the goal to enhance the formation of future engineers once many worldwide changings are in place in terms of geopolitics and a deglobalization of the world. It means that Countries will have more competitiveness in every level. And engineers are problem solvers and creators of advanced technology.

VII. Main Characteristics of the Course

Among others, the most important characteristics of this course for a mechanical engineering program are:

- The classes are designed to be challenging, dynamic, and full of research and practical work;
- They are offered twice a week afternoon and/or evening time;
- Regular length of classes – 50 minutes;
- Some theoretical content is available online based on collaboration among students sharing their own research;
- The course provides an introduction to the Renaissance period of History as a starting point for their project development.

VIII. Expected Results

Throughout this process rooted in serious work rooted in science and personal commitment, the expected results are:

- students will develop leadership and vision;
- realize they are more capable than they thought;
- develop a strong taste for mathematics use;
- develop a creative mind;

- project viewing the future possibilities;
- generate new ideas and patents;
- acquire an entrepreneurial mind;
- improve professional performance.

IX. Conclusion

The relevance of the student's work will be based on the use of mathematics and new materials to build a device based on Leonardo's ideas and work in the engineering field. Leonardo a Renaissance Man who had a thirst for knowledge and applied his energies and time to observe, discover, and create innovations. Always looking to the future.

Innovation occurs in various sectors and can lead to economic and technological growth aimed at improving the quality of life. DaVinci's mind and curiosity are fantastic examples of human capability. Innovation is the keyword for this project. Innovation involves challenging the status quo, being courageous, thinking outside the box (like Leonardo DaVinci did), and taking calculated risks to drive development and achieve innovative results. The investment and persistence are the basis to achieve the proposed goal which is to train the mechanical engineering program students to be engineers ready for the challenge of being creative the skill that will be one of the most important requirements for future generations.

A culture of innovation promotes an open and creative mind where individuals feel empowered to contribute with their ideas and embrace challenges.

The course Leonardo 21 will certainly be a plus for the career of engineers in this engineering program once they will achieve the skills necessary to face future challenges in a world where AI will dominate.

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