ENGINEERING ECONOMICS AND ECONOMIC IMPORTANCE OF ENGINEERING

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ABSTRACT

The engineering profession makes important contributions to the economy, both from the direct addition to economic output from the work they do, and the contribution of the sectors in which they work. Engineering economics is a field that addresses the dynamic environment of economic calculations and principles through the prism of engineering. It is a fundamental skill that all successful engineering firms employ in order to retain competitive advantage and market share. Many schools across the country have integrated courses in engineering economics for their students, thereby providing them with the tools to optimize profits, minimize costs, analyse various scenarios, forecast fluctuations in business cycles, and more. Despite the importance of this field, many universities are unable to effectively teach economic concepts to engineering students in ways they are able to understand. One can also consider the long run return to the economy of improvements in physical infrastructure, in which engineers have played a vital role, and the contributions engineers make tothe knowledge economy and to sustainability.

Key words: *AKTU, Engineering Economics, Collaborative Learning, Curriculum*

INTRODUCTION

Engineering economics studies various financial and economic problems pervasive to engineers in a variety of industries. Like all engineering courses, economics-based engineering courses have a strong quantitative component; however, unlike the more traditional courses, studying engineering economics requires extreme elasticity in learning style that is conducive towards understanding interdisciplinary material. As a result, students who have taken courses in the aforementioned field have adopted a variety of techniques that have been shown, both experientially and empirically, to permit higher order learning and critical thinking. Following the fundamental principles put forth by Benjamin Bloom promotes a well-rounded learning strategy that emphasizes a concrete approach towards evaluation, synthesis, analysis, and more. By understanding the hierarchal structure of this taxonomy, students have successfully supplemented these ideologies into their learning patterns. This paper explores some of the many methods for teaching engineering economics in a way that enables engagement and long-term retention.

It is also the intent of this paper to address the importance of integrating economics into the engineering curricula. Due to globalization and

economic complexity, engineers are now required to have an in-depth understanding of the markets and how changes in these markets affect their bottom line. These can include a variety of things, such as understanding interest rates required to increase or sustain levels of capital stock, opportunity cost, net present value for calculating the value of investments, basic cost and revenue analysis, and more. Once we understand the mechanisms for learning engineering economics and its importance to 21st century engineers, it becomes apparent that this field will play a growing role in shaping successful engineers.

TEACHING ENGINEERING ECONOMICS

The field of engineering economics aims to create value in two domains: real world application and academic theory. As such, there are some key prescriptive recommendations for fostering learning in this field.

Educational Practices. Professors have the distinct responsibility of increasing student achievement. After all, research shows that the classroom environment has the biggest impact on how well students learn. In response,

- **G**uided by the curriculum;
- **R**igorous with research-based strategies;
- **E**ngaging and exciting;
- **A**ssessed continuously to guide instruction;
- **T**ailored through flexible groups. On the other hand, students are also expected to understand the hierarchical structure of learning and be able to solve problems with critical thinking. This taxonomy, established by Benjamin Bloom, promotes these invaluable learning skills to students in a clear method4. As the figure below shows, learning begins with memorization and ends with evaluation. By understanding the basic mechanisms for effective learning, we can now delve into various educational practices and their purpose in engineering economics.

Collaborative Learning. Educators agree that the grouping of students during learning helps to promote critical thinking; actively exchanging ideas among groups increases interest, stimulates participation, and supports evaluating ones' ideas. Based on empirical data, psychologists posit that individual cognitive skills are developed in a social context5. Collaborative learning can be hosted through a variety of mediums, including, but not limited to, big discussions, team work intensive activities, and group projects. Numerous studies show the positive influence collaborative learning had on promoting higher levels of understanding and stronger retention of material. As such, practices have been successfully established in engineering economics courses.

The teams would then present their findings, where a heavy emphasis would be placed on the "written and verbal communication skills." This approach by Professor Cassel, an industry veteran, is imperative for training future engineers revolutionized learning. Students are now able to use software to suit a plethora of needs that were unavailable to them a decade ago. AKTU (Abdul Kalam Technical University) Open Course initiatives are some of the many online tools available to students. They provide lectures on thousands of different topics, including engineering economics, organic chemistry, advanced thermodynamics, differential calculus, and everything in between. Rather than dwell on memorizing information from the books independently, students can now supplement these strategic lectures with their own resources to create a personalized understanding. Computer supported learning further promotes active learning by engaging students in experiential exercises. A recent technique that has been successfully integrated into the classroom is the use of Microsoft Excel. Students have the availability of downloading accurate data from online databases and working together to analyse and project trends for the future. This provides students the opportunity to get into groups, download the data,

build graphs, run statistical tests, analyse external shocks, see various patterns, and more. These innovative methods are imperative for students studying engineering economics, since the techniques and strategies of collaborative quantitative and qualitative analysis are key to fostering interdisciplinary engineers who can observe the markets and streamline their output for producing maximum results.

The goal as an educator of engineering economics should not be to simply convey the material to the students; rather, it should be to enhance and develop students' abilities to learn things at a higher level. By having an understanding of the various learning mechanisms, educators can help facilitate self-learning and thereby create value in the two domains. The recommendations above provide some insight into solutions that have been observed by researchers, scientists, and educators for decades.

THE VALUE OF ENGINEERING ECONOMICS

Engineering economics is a topic that all industry-bound students should learn because of its Real-world applications. In response, AKTU has made engineering economics an integral component of senior design courses in all curricula. Their faculty covers a variety of topics that are relevant to practicing engineers, some of which will be discussed in this section. Engineering economics poses numerous benefits because it allows those in industry to make strategic decisions for their companies.

While macroeconomic and financial competencies are key for business operations, engineering economics further provides a mechanism for decision-making. It forces engineers to think twice before making many choices in everyday operations. The detail and accuracy with which these processes are carried out are another economic calculation based on margins of error, tolerance, reproducibility, and effect on performance. Daily decisions by the engineering firms (based on an economic framework) will decide how successful and profitable that company is.

In most undergraduate engineering programs with courses in engineering economics, there are a number of key topics, among many others, that are generally covered: time value of money, cost analysis, interest rates, economic fluctuations, and depreciation. These subjects are essential for engineering economics because they provide the foundation for engineers to make good decisions in the business environment.

Time value of money is the idea that money has a different value now than it will in the future. This is due to a number of dynamic variables, such as inflation and interest rates. These values are standardized through present and future value calculations, thereby equalizing the time dependent variables. This is very important for engineers because these calculations provide an intuition as to how money should be spent and saved, how cash flow should be negotiated in contracts, and how interest rates can affect the present and future values.

Interest is another concept that is important to economical engineers. Many times, engineering firms take out significant loans to finance construction of major projects. Having a clear understanding of the cost of borrowing money is crucial to making appropriate business decisions.

CONCLUSIONS

The marriage between economics and engineering is one of the successes of engineers in the 21st century; the interdisciplinary nature of the topic offers key insight into the underlying mechanisms that drive daily business operations. Engineering economics is an integral component to many engineering curricula across the country, covering a wide variety of topics including the time value of money, cost analysis, interest rates, economic

fluctuations, depreciation, and everything in-between. Furthermore, it has been noted by renowned engineer John Hayford that engineering and economics "help to develop the very valuable habit of thinking in terms of groups rather than of individuals." By understanding and implementing the outcomes, framework, and tools for actively teaching engineering economics, future engineers can continue evolving as problem solvers and innovators.

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