

The Teaching of Engineering in the Perception of Mechanical Engineering Graduates from the Universidade Estadual de Campinas

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1. Introduction

The specific context of the capitalism of the end of the century, mainly the last two decades, associated with the vast and radical transformations in the several spheres of the political, economic and social life and, in particular, the world of the production, requires significative innovations in the teaching of engineering. The economy of commodities is being substituted by the economy of specialties. There is a growing need of product innovation, the use of new technologies, and new forms of business administration. The changes above mentioned and other important ones imposed by today's capitalist system demand from the engineers a new and adequate performance at work, conditioning the changes in their education.

This picture requests from those who will occupy key positions in the productive process, capacity to give fast and well based answers; ability to analyze and solve challenging problems; capacity to adapt to the new labor market (2). The student must learn how "to learn". Today's student needs to develop and improve abstract and systemic reasoning. Experimentation and collaboration (5), are also key words in today's competitive economy and labor market demanding a new and refined engineer.

In previous work (1) we showed that most of the abilities requested to manage the present status of the productive system, considering its relatively new transformations were successfully contemplated in the recent curriculum modification in the School of Mechanical Engineering at Universidade Estadual de Campinas: the curriculum proposed by the School is in agreement with the more current educational tendencies demanded by the dynamics of the economy (3,4). With the purpose of deepening the discussions on engineering education, it is also of our interest to consider some aspects of the professional reality the mechanical engineers will face. Based in a qualitative view of the educational phenomenon, we analyzed the information supplied by 48 Mechanical Engineers graduated at Unicamp in the period previous to the implementation of the new curriculum (1972 to

1994). Next, we will present the results of the research conducted with this group of graduates. Items studied included the nature of the company they worked for; the process of professional evolution; the compatibility of the education they received with the professional needs; the education and professional's profile demanded by the Brazilian labor market and the fulfillment of personal expectations. Important considerations on the quality of their professional education, relevant to the Brazilian labor market, were made by the engineers.

The Graduates: Work situation and characteristics of the company

Practically all the engineers who answered the questionnaire work in typical areas of mechanical engineering or closely related to it. Most of them work in industry (63%) and, following the new tendencies of the labor market, a significant percentile works in the sector of services (24%). The Metallurgy and Mechanical sectors are strongly represented (46%), followed by "other services" (26%) and in a smaller scale by chemical/ petrochemical industries (5,5%), pharmaceutical/ cosmetics (5,5%), food and beverages (6,5%), and trade (6,5%). Most of the engineers work in private companies (63%); 14,5% in the public sector, mainly in universities. 4% work in the so called "companies of mixed economy" (private/public), 12,5% have their own company and, 6% don't have a formal activity as considered by the Brazilian legislation. Still, within the category "the characteristics of the companies", 52% of the firms are in the group "national capital." 40% of the companies are controlled of foreign capital. Considering the nature of the labor carried out by the graduates, we saw that a large population of them (60%) work in management. Included in this sub-group are high level managers (general directors), industrial managers, industrial strategists, supervisors of operations and manufacturing. 31% work as advisors, team workers in projects, as supervisors in production and process development, sales, and in research. With respect to the degree of modernization of the companies, 62,5% of them can be considered modern companies

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well adapted to the technological level of this decade, requiring modern management techniques.

Considerations about the graduates' critical view of their education at Universidade Estadual de Campinas

The great majority (94%) of graduates consider themselves as successfully rising in their professional career. This success is attributed by most of them (86%) to the high quality of their education at the School of Mechanical Engineering at Universidade Estadual de Campinas. The selection process, the regular course work at the university, and training in industry while at school, were considered decisive to get the first job, today a critical step in a professional carrier in Brazil. 56% of the graduates said that the formation received in the School of Mechanical Engineering was only "partly compatible" with the demands of the profession, and 44% considered their education as totally compatible. Those who affirmed to have received a formation "partially compatible" with the professional demands, justified their answers with the following statements: incompatibility of the university world with the "reality" of the labor market and the theoretical emphasis of the course (as opposed to a more "practical" and applied methodology). It was also quite appealing to them the fact that the curriculum of the course was not limited to simple training in managerial activities but instead, was more complex, including also the study of personal relationships at the work (team-work). Other important statements cited were: the high level of the faculty (well qualified), accessibility to teachers who also develop advanced research, acquisition of wide general and fundamental knowledge, solid theoretical and technological background, an adequate perspective, close-to-reality view of the engineering field, the familiarity with the frontier of technology in the field of mechanical engineering. The university atmosphere, understood as culturally challenging and motivating, associated to the colleagues' high cultural level were also mentioned as positive aspects of their education. Computer science, automation, and electronics were considered innovative areas that constituted challenges to be faced. A closer integration with other areas, especially with humanities was perceived as a need resulting from their work experience. Furthermore, they pointed out the need to further study of administration notions, the need to emphasize group work, production management, quality control, and environmental awareness.

It should be pointed out that 62,5% of the engineers affirmed that they didn't have difficulties in accompanying recent developments in industry, especially technological ones, due to the high quality of their education, attributed by them to two basic points: strong theoretical formation and a "generalist"

approach as opposed to a more specialized approach. One's effort, dedication, determination to learn, study habits, and learning capacity were also mentioned as factors which contributed to their success. Access to continuous education, graduate studies and courses, and on the job training were considered as important assets when possible to be achieved in the work environment. Graduates considered that the University should emphasize a broad and high quality formation. The most specific formation, according to them, can be acquired in the labor market and in graduate or extension courses.

Final Considerations

Finally, the present study shows that, as we analyze the views expressed by the graduates of the School of Engineering at the Universidade Estadual de Campinas, the curriculum change in the School, implanted in 1990 is quite adequate to the needs of the present labor market, and meet the challenges of the future as we perceive it from this point in history. In spite of these considerations we suggest that new changes become necessary in order to bring the future mechanical engineers closer to a reality where the humanities become strongly necessary not only to the management of production and people but also to the understanding of a challenging and complex society.

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