NKU-Mazak Corp. Joint Senior Project Program

Dr. Morteza Sadat-Hossieny, Northern Kentucky University

Morteza Sadat-Hossieny is an associate Professor and Director of Mechanical and Manufacturing Engineering Technology at Northern Kentucky University. Dr. Sadat-Hossieny is actively involved in consulting and research in the areas of Alternative Energy, Industry-University Collaborations, and technology transfer mechanizes in manufacturing. Dr. Sadat-Hossieny received a B.S. degree in Mechanical Engineering Technology for Oklahoma State University in 1983, an M.S. in Manufacturing Engineering Technology from Murray State University in 1985, and a Ph.D. in Industrial Education and Technology from Iowa State University in 1989.

Dr. Mauricio Torres, Northern Kentucky University

Dr. Torres received a B.S. in Business Administration from City University of Sao Caetano do Sul, B.S. in Mechanical Industrial Engineering from Braz Cubas University, Brazil, M.S. in Engineering Management and Ph.D. in Industrial and Systems Engineering from Florida International University. He has over 30 years of experience in the heavy machinery manufacturing industry and currently holds the position of Assistant Professor in the Mechanical Manufacturing Engineering Technology Program at Northern Kentucky University. His research interests are manufacturing processes and enterprise engineering.
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Abstract

Mazak in cooperation with NKU Engineering Technology is carrying an innovative training program aimed to provide students with ‘hands-on’ industrial experience, as part of graduation requirements. This innovative learning experience incorporates many elements of the case method in experiential learning. The advantages for this university-industry joint effort are:

1. The resources available to students and the hand on experience provided to the students in the Mazak facility cannot be emulated in school, even in the laboratory type classes.
2. From the students’ side there is no additional cost involved as the project is fully sponsored by Mazak.

Eighteen students have been assigned to nine different industrial projects ranging from product improvement to optimization of manufacturing processes. Example of the project titles are: Automatic Assembly of Dangerous Materials, Robot Electrical Test Box for CNC Machines, etc. Using data obtained from surveys conducted during the semester we will assess student’s performance and make the necessary adjustments to improve the program.

Introduction

Mazak is the global leader in the design and manufacture of highly productive CNC machine tools and automation systems established in Northern Kentucky since 1974, and has spent the past several decades continuously improving its manufacturing operations and enhancing its technology to be able to immediately address its customers’ changing needs.

Founded in 1968, Northern Kentucky University (NKU) is a metropolitan university with 16,000 students, located in Highland Heights, KY, in the greater Cincinnati area. NKU currently offers Bachelors of Science degrees in Engineering Technology (Electronics - EET and Mechanical and Manufacturing - MMET), with the support of local industry, who provide most of the students with Co-op opportunities.

Several efforts have been made to design new learning methods in order to train novice technology professionals and engineers about the production concepts in diverse manufacturing areas as well as teaching students in novel ways to transfer real world applications to educational class [1].

What makes this university-industry cooperation novel is that it is a part of our academic program, being taught under NKU faculty and Mazak management supervision, at their facility. The students will utilize all knowledge acquired through the program and as a culminating effort towards graduation they will submit a senior project to be built and tested on Mazak site. The advantages for this university-industry joint effort are:

1. The resources available to students and the hand on experience provided to the students in the Mazak facility cannot be emulated in school, even with the capital cost expenditure
made by schools in order to obtain and maintain laboratory environments that reflect the modern industrial facility [2].

2. From the students’ side there is no additional cost involved as the project is fully sponsored by Mazak.

3. Mazak benefits from this program by the opportunity of their employees interact with highly academically trained students, fully dedicated to experimental initiatives.

According to Todd et al. [3], it is essential to keep in mind that industry is an important customer of engineering education. Ignoring this relationship has produced graduates that often fail to meet the changing needs of industry. One of the objectives of cooperation with our industrial partners in senior projects is to be able to receive feedback from our industrial customers. Faculty from Mechanical and Manufacturing Engineering Technology at Northern Kentucky University are determined to improve the capstone project course to make one of its central objectives to undertake projects that are essential to our industrial partner’s needs. These projects are intended to involve both product and process design activities. Multidisciplinary teams of students are selected and taught a structured development approach to produce typical industrial deliverables. These deliverables include a functional specification, product and process design, prototype, and first production sample.

The Training Program as an Experiential Learning

We believe that experience should be a central component of the educational process [4]. For an experience to be educational, it must possess continuity and interaction. Continuity refers an “experience chain,” where one experience leads to additional experiences prompting an individual to learn more [5].

Experiential learning is a philosophy of learning which encompasses the traditional learning theories but emphasizes that the source of the learning material can be from experience, as opposed to the more traditional view of classroom and lectures [6]. This program incorporates many elements of the case method in experiential learning [7], which have been largely used in a variety of disciplines.

We use four key elements through which a learner cycles in a continuous spiral of learning, as depicted in Figure 1. The four elements are (i) exposure to a concrete experience, (ii) reflection on that experience, (iii) generalization of the experience and formation of abstract concepts based on the generalization, and (iv) application of these concepts to the concrete experience as proposed by Kolb [8].
In order to improve the program, the measurement and evaluation process as shown in Figure 2 is carried out, in the way described by Mutaliba et al. [9]. This evaluation process must be suitable with the expected course outcomes and the delivery method, as previously defined by Jaffar, et al. [10] in his assessment strategy for outcome based education.

![Figure 1 - Kolb’s experiential learning cycle](image)

In this program the projects topics are defined by Mazak staff according to a row of production issues requiring solution and/or improvement and will be assigned to the students by NKU faculty. Results from evaluations made by Mazak staff and NKU faculty will be used to improve the program, as depicted in figure 3.

![Figure 2 - Process of measuring and assessing program objectives and outcome](image)
Evaluation

We evaluate the projects learning activities in view of the development/reinforcement of a certain set of student abilities and skills, namely those that were acquired in the EGT program, as proposed by Otta & Pozzia [11].

Using data obtained from surveys conducted during the semester we assess student’s performance, analyzing items such as the ability to solve problems using technical knowledge, pace of the work, ability to manage time and resources, and the degree of achievement of the projects objectives. Feedback from Mazak staff is used to measure their general satisfaction with our student’s professional conduct and technical proficiency. We also use these evaluations to support the MMET (Mechanical & Manufacturing Engineering Technology) program continuous improvement program, as depicted in figure 4. Finally we assess the extent to which these projects help the MMET Program addressing the attainment of its’ Student Learning Outcomes as defined by ABET [12].
Findings from feedback received indicate more emphasis on the following contents:

- Better understanding of manufacturing processes.
- Stronger design capability.
- More focus on teaching the overall project engineering process.
- Teach students to get involved and provide feedback toward their projects.
- More emphasis on communication skills.
- Explore the reason for the gap between the degrees of success between domestic students vs. International students in completing their senior projects to the satisfaction of our industrial partner.

Conclusion

In face of today’s increasingly competitive scenario, manufacturers are striving to maintain their competencies and schools are being required to devise different ways to offer proper education to graduates who ultimately will became part of their workforce. Literature abounds in discussions on the advantages of experiential learning and the design of training programs to cope with manufacturers’ requirements.

The NKU/Mazak Corp. Joint Senior Project Program offer the opportunity to expose graduates to actual industry environment which cannot be emulated in school; that exposition uncover some facets only visible from the employer point of view and we capitalize on that. The feedback provided by the users (students and Mazak staff) is key to the NKU Engineering Technology programs continuous improvement. Findings and feedbacks received requires that, we adjust the course contents and direct our educational resources to strengthen the topics.
pointed out by our industrial partners. This will enrich the learning experience and will provide our graduates with a competitive advantage through an engineering technology education consistent with industry expectations.

References


