Development of Experiential Activities on the Toyota Lab for NTID’s Deaf and Hard-of-Hearing Student Population

Principal Investigators

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[1] SUMMARY

This proof-of-concept proposal seeks to leverage collaboration between COE and NTID faculty to adapt, incorporate and deliver a 2-part series of experiential activities into one course (with 8-10 sections) for NTID’s associate degree programs in engineering studies. These activities, currently offered only to COE engineering students, utilize active and collaborative learning principles within the state-of-the-art Toyota Production Systems Lab located in COE, to emphasize the skills of problem solving, continuous improvement, team building and systemic thinking. These activities are typically staged on a real assembly line for automotive components and take place during a “live” production run where the students perform as operators and systems analysts. According to industry feedback, hands-on exposure to the material and experiences in the lab by the NTID student population will provide them with tools, skills and techniques that are valued by prospective employers. Additionally, it is expected that the delivery format, which heavily relies on active/collaborative learning approaches, will be particularly attractive to deaf and hard-of-hearing students. A video and pictures of the facility and some of the activities can be found in the lab website at: http://www.rit.edu/kgcoe/ise/facilities/ToyotaLab/ (use windows media player). Funding is solicited to support faculty time over the summer to adapt existing material to the deaf and hard-of-hearing populations, to train several NTID instructors on the delivery of the content, as well as to develop a road map for implementation. It is anticipated that these experiences be delivered during the AY 2010-2011 and that further collaborative efforts between NTID and the Toyota Production Systems Lab will span from this initiative.

[2] TARGETED LEARNERS AND NUMBER OF STUDENTS IMPACTED

The target audience for this proposal is comprised of first year students entering the “Engineering Fundamentals” course (0813-220) during the AY 2010-2011. This course is offered by the Department of Engineering Studies in the National Technical Institute for the Deaf. This is a required course for deaf and hard of hearing students who will be pursuing their technical associated degrees in AT, CADT, CIMT, or NAMA. This course is offered every Fall and Winter in several sections (6-8 sections with 8-10 students each). Finally, there may be the occasional deaf and hard of hearing student from the NAPE (NTID Pre-BACC program) who could also benefit this type of activity. The total number of students who will participate in the proposed activity falls in the range of 45-60 students. This is the cumulative number for the academic year (among several sections in both Fall and Winter).

[3] NEW OR EXISTING COURSE

This development involves an existing course but delivered to a new, very unique, audience residing on a different college.
[4-5] IMPACT ON TEACHING, LEARNING AND STUDENTS SUCCESS

This proposal aims to incorporate innovative lab experiences that will facilitate and enhance the delivery and retention of some of the current course objectives as well as of additional ones. The specific cognitive skills targeted by the proposed activity are knowledge, comprehension and application on Bloom’s taxonomy (Bloom and Krathwohl, 1956) on the following topics:

- A specific problem solving methodology (PDCA)
- A continuous improvement framework (Toyota House)
- Technical Communication (A3 proposal)
- Teamwork
- Systemic thinking

The activities in the lab involve experiential approaches, that is, exposing the students to a situation on a real assembly line and asking them to perform. This delivery format, used for nearly 9 years in the Toyota lab, has proved to be extremely effective with engineering students. One of the reasons for this success is because this approach is soundly rooted in proven learning approaches of active learning and collaborative learning.

Active learning involve activities that engage students into an activity, besides listening to a lecture and taking notes, that help them learn and apply course material. Essentially, active learning is a learn-by-doing approach that results in one of the highest percentages of knowledge retention (Dale, 1972). The “cone of learning” approach developed by Dale (1972) shows that the highest percentage of knowledge retention (measured after two weeks) is achieved when students participate in a hands-on activity. Cooperative learning is a process whereby students interact with one another while they learn and apply course material. Some of the benefits of cooperative learning that have been realized include improved student-faculty and student-student interaction, higher information retention, improved teamwork, better development of interpersonal and communication skills, better attitude towards subject matter, and lower levels of anxiety (Felder and Brent, 1994). Johnson et al. (1991), found that one of the reasons for the higher retention achieved in cooperative learning approaches is due to the process of cognitive rehearsal, in which students, like professors, learn best when they teach the subject to one another.

With proper adaptation of the material, it is expected that this delivery format will be particularly attractive to deaf and hard-of-hearing students. One of the team members on this proposal, Wendy Dannels, has had significant experience teaching lean concepts to these audiences (Department of Defense, 2010). Similar experiences delivered in engineering courses have helped students secure co-op and permanent job opportunities. It is anticipated that students, enriched by this hands-on experience on key skills, will become more attractive to prospect employers. Additionally, the active and collaborative learning approach is likely to foster an enhanced retention of knowledge on the participants.

[6] ASSESSMENT OF IMPACT

As part of the proposal, the principal investigators will work over the summer to develop a custom rubric that would be used to assess the learning experience. This rubric will be administered during the fall and winter quarters with improvements to the delivery implemented for the second quarter. Additionally, the student achievement on the skills will be evaluated as follows:

- Application of a specific problem solving methodology (PDCA) and ability to communicate technical data
  - The students will explain how the PDCA cycle generally works in their lab report and will apply it during the development of a “problem solving A3”. Within the A3 report, students will
review the current and future state, targets and goals, root cause analysis and problem breakdown, as well as development of countermeasures.

- Application of a continuous improvement framework
  - Via systematic improvements on a physical simulation of assembly scenarios, the students will demonstrate the “before” and “after” comparison in their lab report

- Ability to work in teams
  - The students will perform collaborative learning activities and share their experience in their lab report.

- Development of systemic thinking skills
  - The students will demonstrate systematic improvements on a physical simulation of assembly scenarios and discuss it in lab report.

[7] RATIONALE

This proposal, if funded, will foster a cross-college collaboration that would not have happened otherwise. The proposed activities currently take place on a given college (COE) and within courses that restrict participation to students outside engineering. However, the technically-inclined NTID students could greatly benefit from these experiences and would likely place themselves in a better position to secure a job or a co-op. Toyota Motor Manufacturing & Engineering North America has expressed interest in attracting deaf and hard-of-hearing students who possess this type of knowledge and skills. This collaboration and joint delivery of content by faculty from two different colleges is not part of the regular college business in either COE or NTID.

In response to the committee’s request to lower the budget, this team behind this proposal lowered the request to $10,000 (from $12,000) and secured matching funds of additional $10,000 from both colleges ($5,000 from NTID and $5,000 from COE). Also, in revising the impact scale, the team will be training a number of NTID faculty on the methods and cases for future delivery. This expanded scope requires additional funding that was pledge by NTID and COE (as shown in the budget). This, along with the letters of recommendation from NTID and COE, speak to the significance of the project. It should be noted that, although the measure of impact mentioned by the PLIG committee (dollars requested per number of students impacted) may seem high, this project requires working on hands-on experiences with a linguistic minority with special needs. This imposes special conditions on staffing, safety protocols, and number and sizes of sections that increase the effort significantly.

Finally, this collaboration is likely to extend to other areas of mutual interest between the Toyota Production Lab and the Department of Engineering Studies at NTID. The intention is for this proposal to be the first step of a sustained effort. This proposal is likely to be used as a foundation to pursue additional external funding such as NSF or SME. In addition, the following individuals have expressed strong support for this project: Dr. DeCaro (Interim President of NTID), Dr. Harvey Palmer (KGCOE Dean), Dr. Laurie Brewer (Vice-Dean and Interim Associate VP for Academic Affairs), Dr. Jacqueline Mozrall (Department Head, Industrial and Systems Eng.), and Kimberly Demko (Toyota Motor Manufacturing and Engineering North America).

Credentials of involved faculty:

- Andres Carrano: is an associate professor in Industrial and Systems Engineering at the KGCOE and the Director of the Toyota Production Systems Lab. He led a previous PLIG effort in 2002 which supported the creation of the award-winning Toyota Production Systems Lab and that resulted in several publications. He is the co-recipient of the 2010 IIE “Excellence in Teaching Lean Concepts” award. More information can be found at http://people.rit.edu/alceie.
• **John Kaemmelen**: is a full time lecturer in Industrial and Systems Engineering and Associate Director of the Toyota Lab. He brings more than 30 years of experience at Kodak in Lean and production systems. He is the co-recipient of the 2010 IIE “Excellence in Teaching Lean Concepts” award.

• **Wendy Dannels**: is a full time instructional/support faculty in NTID Department of Engineering Studies. She has experience and expertise to develop training materials and various tools to train deaf and hard-of-hearing people the Toyota Way concept. Prior to joining RIT/NTID, she worked for several engineering corporations for over seventeen years where she led and participated in various kaizen events to meet several critical customer priorities aligned to strategic planning and policy deployment.

• **Dino Lauria (Laury)**: is an assistant professor and an Interim Department Chairperson in NTID's Department of Engineering Studies. He brings in more than 15 years of deaf and hard of hearing education experience from NTID. Under his leadership, the Department of Engineering Studies has undertaken several STEM activities and grants opportunities.

[8] **TIMELINE**

**Summer AY 2009-2010:**
- Development and adaptation of the instructional material.
- Develop rubric assessment.
- Develop the visual signals and controls to ensure an effective and safe delivery of the activity.
- Training of course instructors. This includes familiarization with the lab equipment and procedures and practice-runs of the lab experiences.

**Fall AY 2010-2011**:
- Delivery of a lab experiences to NTID students by a team of NTID/COE instructors (October)
- Administration of rubric and collection of qualitative feedback. (October)
- Brainstorm and debrief meeting with instructors (October)
- Principal investigators to review the results from rubric assessment. Writing of a 2-page summary containing feedback and improvement suggestions. Implement improvements to rubric, if needed. (November)

**Winter AY 2010-2011**
- Delivery of a lab experiences to NTID students by a team of NTID/COE instructors. (January)
- Administration of rubric and collection of qualitative feedback. (January)
- Instructors to meet to discuss survey results and share their observation and experience (February)
- Principal investigators to review the results from rubric assessment and compare with previous quarter. Writing of a 5-page summary containing feedback and improvement suggestions. (February)

**Spring AY 2010-2011**
- Principal investigators to discuss experience with respective Department Heads and Deans/NTID President to explore possible extensions and future collaborations. (March-May)
- Writing of the final report to the PLIG committee. (March-May)
- Dissemination of the effort within NTID and COE colleges and around pertaining academic units of RIT. (March-May)
- Writing of an article for magazine, conference, etc. (March-May)
REFERENCES