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Assessment and Evaluation of Engineering, ICT and Architecture Program Outcomes Using ABET Criteria for LPU - Cavite

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Abstract **Program outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge and behaviors that students acquire as they progress through the program. ABET accreditation has placed a heavy emphasis not only on the assessment of objectives and outcomes, but also on the evaluation of them and subsequent efforts for continuous improvement. What is lacking in current practice is a systematic way to examine the success of a program based on a set of interlinked outcomes assessment processes. The new processes should accommodate differentiation between the data collection efforts associated with outcomes assessment. Such a separation is particularly important since ABET has recently adopted a change in engineering accreditation criteria that partitions outcomes assessment the day of graduation. The procedures described in this paper accommodate the changes in criteria while providing a systematic approach that eliminates redundancy in data collection, targets relevant constituents for input, and reduces strain on limited resources.**

Keywords: **assessment; evaluation; objectives; ABET.**

I. INTRODUCTION

The Lyceum of the Philippines University Cavite (LPU – Cavite) envisions itself to be an internationally accredited University dedicated to innovation and excellence in service to God and Country. True in its vision and mission to provide quality education to all its stakeholders, the young University believe that the requirements and standards of ABET accreditation for engineering programs must be achieved.

ABET accreditation has focused not only on the assessment of objectives and outcomes of engineering programs, but also on the evaluation of them and the subsequent efforts toward continuous improvement based on such evaluation. The University, with its effort to meet ABET expectations, documented step by step the procedures to achieve this goal. The accrediting body requires to [1] document processes for regularly assessing and evaluating the extent to which the program's educational objectives and student outcomes are being attained and [2] document the extent to which the program's educational objectives and student outcomes are being attained.

In this paper, the researcher aim to contribute by actually demonstrating how each of these expectations can be met step by step covering all the engineering programs:

1. Bachelor of Science in Civil Engineering (BS CE)
2. Bachelor of Science in Computer Engineering (BS CpE)
3. Bachelor of Science in Electrical Engineering (BS EE)
4. Bachelor of Science in Electronics Engineering (BS EcE)
5. Bachelor of Science in Industrial Engineering (BS IE)
6. Bachelor of Science in Mechanical Engineering (BS ME).

7. Bachelor of Science in Architecture
8. Bachelor of Science in Information Technology
9. Bachelor of Science in Computer Science
10. Bachelor of Library & Information Science

Ultimately, this research would determine which program outcomes needs improvement. With this, it will be clear that the identification of the areas for improvement will be systematic and deliberate. The result of all the activities will positively contribute toward better learning experiences by students in engineering programs. It will also be clear that the pieces of evidence supporting the findings of this research will come from the students.

Program Outcomes

LPU – Cavite College of Engineering, Computer Studies and Architecture and its dynamic roster of faculty members uses both theoretical and practical approach that will provide students with the knowledge to become competitive locally and internationally. This mission presents a clear vision for an educational philosophy that matches closely the goals of the undergraduate college of engineering, computer studies & architecture; to provide students with the kind of training that will allow them to make a difference in the nation and in the world. To achieve this vision, the engineering, ICT and architecture programs of LPU Cavite must be responsive to the needs of relevant industries such as construction, semiconductor, manufacturing and ICT services. Hence, the feedback from the students provide information that should be used to improve its programs through efforts towards continuous improvement.

This Vision – Mission based philosophy greatly influences the assessment and evaluation process program outcomes. In what follows, the University describes the program outcomes and their relationships:

- Engineering

a. Apply knowledge of mathematics and science to solve engineering problems;

b. Design and conduct experiments, as well as to analyze and interpret data;

c. Design a system, component, or process to meet desired needs within realistic constraints, in accordance with standards;

d. Function in multidisciplinary and multi-cultural teams;

e. Identify, formulate, and solve engineering problems;

f. Understand professional and ethical responsibility;

g. Communicate effectively engineering activities with the engineering community and with society at large;

h. Understand the impact of engineering solutions in global, economic, environmental and societal context;

i. Recognize the need for, and engage in life long learning;

j. Know contemporary issues;

k. Use techniques, skills, and modern engineering tools for engineering practice.

l. Know and understand engineering and management principles as a member and leader of a team, and to manage projects in a multidisciplinary environment;

- Computer Studies

a. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions

b. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline

c. Communicate effectively in a variety of professional contexts

d. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles

e. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline

f. Apply computer science theory and software development fundamentals to produce computing-based solutions

- Architecture

a. Keep abreast with the developments in the field of architecture practice.

b. Effectively communicate orally and in writing using both English and Filipino

c. Work effectively and independently in multi-disciplinary and multi-cultural teams

d. Take cognizance of professional, social, and ethical responsibility

e. Create architectural solutions by applying knowledge in history, theory, human behavior and environmental context

f. Produce and present design solutions by applying architectural principles, programing, universal design, planning, building systems and professional practice.

g. Use of concepts and principles from specialized fields and allied disciplines into various architectural problems

h. Use of various information and communication technology (ICT) media for architectural solutions, presentation, and techniques in design and construction.

i. Prepare contract documents, technical reports and other legal documents used in architectural practice adhering to applicable laws, standards and regulations.

j. Interpret and apply relevant laws, codes, charters and standards of architecture and the built environment.

k. Acquire of entrepreneurial and business acumen relevant to architecture practice.

l. Contribute in the management of the construction works and building administration

m. Participate in the generation of new knowledge

n. Recognize the need for and engage in life-long learning

II. METHODOLOGY

Student Outcomes Assessment and Evaluation

This section explains the assessment and evaluation processes for the student outcomes. For the assessment of the student outcomes, the researcher used the indirect approach using student and alumni-driven surveys.

- Indirect Assessment by the Students and Alumni Driven Surveys.

In this method, graduating seniors are asked about each student outcome in the form of:

Rate your personal assessment on the following program: (1=not attained, 2=slightly attained, 3=attained , 4= highly attained)

Seniors are the most appropriate students for the survey as their opinions by the time of their graduation is summative.

Expected Level of Attainment

There is also no single number from a single source that will assure the attainment of each student outcome. However, by the design of the survey questionnaires (a numerical score of 1 – 4), an average score of an outcome that is greater than 2 in a survey can be viewed as evidence illustrating that the level of the program outcome achievement is satisfactory.

III. RESULTS AND DISCUSSIONS

The results from the returned survey forms are summarized in Tables 1a , 1b, and 1c.

Engineering

For Civil Engineering, it was observed that the average numerical scores from the student respondents are all higher than 2 concurrently. PO6: *Understand professional and ethical responsibility* and PO13: *Understand at least one specialized field of engineering practice* got the highest mean scores of 3.80 while PO3: *Design a system, component, or process to meet*

desired needs within realistic constraints, in accordance with standards got the lowest mean scores of 3.60. Hence it is concluded that each program outcome is satisfactorily attained at this point in time. Furthermore, it was also observed that the results are precise which validates that values indicate the actual extent of the attainment.

For Mechanical Engineering, it was observed that the average numerical scores from the student respondents are all higher than 2 concurrently. PO6: *Understand professional and ethical responsibility* and PO9: *Recognize the need for, and engage in life long learning* got the highest mean scores of 3.90 while PO2: *Design and conduct experiments, as well as to analyze and interpret data*, PO3*: Design a system, component, or process to meet desired needs within realistic constraints in accordance with standards*, PO4: *Function in multidisciplinary and multi-cultural teams*. PO11: *Use techniques, skills and modern engineering tools necessary for engineering practice* and PO12: *Know and understand engineering and management principles as a member and leader of a team, and to manage projects in a multidisciplinary environment*, got the lowest mean scores of 3.76. Hence it is concluded that each program outcome is satisfactorily attained at this point in time. Furthermore, it was also observed that the results are precise which validates that values indicate the actual extent of the attainment.

For Industrial Engineering, it was observed that the average numerical scores from the student respondents are all higher than 2 concurrently. PO11: *Use techniques, skills and modern engineering tools necessary for engineering practice*, PO12: *Know and understand engineering and management principles as a member and leader of a team, and to manage projects in a multidisciplinary environment and* PO13: *Understand at least one specialized field of engineering practice* got the highest mean scores of 3.80 while PO5: Identify, formulate, and solve engineering problems got the lowest mean scores of 3.63. Hence it is concluded that each program outcome is satisfactorily attained at this point in time. Furthermore, it was also observed that the results are precise which validates that values indicate the actual extent of the attainment

For Computer Engineering, it was observed that the average numerical scores from the student respondents are all higher than 2 concurrently. PO6: *Understand professional and ethical responsibility*, PO7*: Communicate effectively engineering activities with the engineering community and with society at large; and* PO13: *Understand at least one specialized field of engineering practice* got the highest mean scores of 3.75 while PO1: *Apply knowledge of mathematics and science to solve engineering problems*; PO4: *Function in multidisciplinary and multi-cultural teams* ; PO5*: Identify, formulate, and solve engineering problems; and PO12: Know and understand engineering and management principles as a member and leader of a team, and to manage projects in a multidisciplinary environment*; got the lowest mean scores of 3.25. Hence it is concluded that each program outcome is satisfactorily attained at this point in time. Furthermore, it was also observed that the results are precise which validates that values indicate the actual extent of the attainment

For Electronics Engineering, it was observed that the average numerical scores from the student respondents are all higher than 2 concurrently. PO1: *Apply knowledge of mathematics and science to solve engineering problems*; PO5*: Identify, formulate, and solve engineering problems;* PO9: *Recognize the need for, and engage in life long learning; and PO12:* Know and understand engineering and management principles as a member and leader of a team, and to manage projects in a multidisciplinary environment; and PO13: *Understand at least one specialized field of engineering practice* got the highest mean scores of 3.80 while PO2: *Design and conduct experiments, as well as to analyze and interpret data* and PO11: *Use techniques, skills and modern engineering tools necessary for engineering practice* got the lowest mean scores of 3.25. Hence it is concluded that each program outcome is satisfactorily attained at this point in time. Furthermore, it was also observed that the results are precise which validates that values indicate the actual extent of the attainment

For Electrical Engineering, it was observed that the average numerical scores from the student respondents are all higher than 2 concurrently. PO11: *Use techniques, skills and modern engineering tools necessary for engineering practice* got the highest mean score of 4.00 while PO1: *Apply knowledge of mathematics and science to solve engineering problems*; PO4: *Function in multidisciplinary and multi-cultural teams*; PO5*: Identify, formulate, and solve engineering problems; and* PO10: *Know contemporary issues* got the lowest mean scores of 3.83. Hence it is concluded that each program outcome is satisfactorily attained at this point in time. Furthermore, it was also observed that the results are precise which validates that values indicate the actual extent of the attainment.

For the overall rating, it was observed that the Electrical Engineering program got the highest level of program outcomes attainment with a mean score of 3.89 while the Computer Engineering program got the lowest level of attainment with a mean score of 3.48. In terms of the program outcomes, the overall attainment rating is 3.74 which is attained. PO13 *Understand at least one specialized field of engineering practice* got the highest attainment rating of 3.84 among the thirteen (13) program outcomes of engineering while PO4 *Function in multidisciplinary and multi-cultural teams* got the lowest attainment rating of 3.65.

Computer Studies

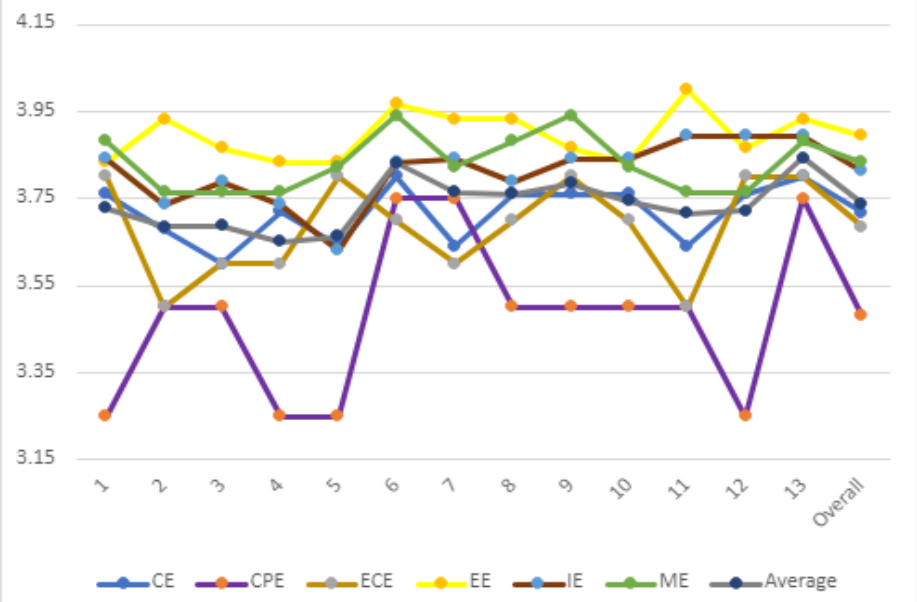
For Computer Science, it was observed that the average numerical scores from the student respondents are all higher than 2 concurrently. PO1, PO2, PO3, PO4 and PO6 got the highest mean scores of 4.00 while PO5: *Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline*; got the lowest mean score of 3.088. Hence it is concluded that each program outcome is satisfactorily attained at this point in time. Furthermore, it was also observed that the results are precise which validates that values indicate the actual extent of the attainment.

For Information Technology, it was observed that the average numerical scores from the student respondents are all higher than 2 concurrently. PO4*: Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles*; and PO6: *Apply computer science theory and software development fundamentals to produce computing-based solutions* got the highest mean scores of 3.72 while PO5: *Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline*; while PO2: *Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline* got the lowest mean score of 3.63. Hence it is concluded that each program outcome is satisfactorily attained at this point in time. Furthermore, it was also observed that the results are precise which validates that values indicate the actual extent of the attainment.

For Library & Information Science, it was observed that the average numerical scores from the student respondents are all higher than 2 concurrently. PO1, PO2, PO3, PO4, PO5 and PO6 got the highest mean scores of 4.00. Furthermore, it was also observed that the results are precise which validates that values indicate the actual extent of the attainment.

Table 1a Graduating Students Survey Results (Engineering)

Criterion	**CE**	**ME**	**IE**	**CpE**	**EcE**	**EE**	**Total**
No. of Respondents	25	17	19	4	10	30	105
1. Apply knowledge of mathematics and science to solve engineering problems;	3.76	3.88	3.84	3.25	3.80	3.83	3.73
2. Design and conduct experiments, as well as to analyze and interpret data;	3.68	3.76	3.74	3.50	3.50	3.93	3.69
3. Design a system, component, or process to meet desired needs within realistic constraints, in accordance with standards;	3.60	3.76	3.79	3.50	3.60	3.87	3.69
4. Function in multidisciplinary and multi-cultural teams;	3.75	3.76	3.74	3.25	3.60	3.83	3.65
5. Identify, formulate, and solve engineering problems;	3.64	3.82	3.63	3.25	3.80	3.83	3.66
6. Understand professional and ethical responsibility;	3.80	3.94	3.83	3.75	3.70	3.97	3.83
7.Communicate effectively engineering activities with the engineering community and with society at large;	3.64	3.82	3.84	3.75	3.60	3.93	3.76
8. Understand the impact of engineering solutions in global, economic, environmental and societal context;	3.76	3.88	3.79	3.50	3.70	3.93	3.76
9. Recognize the need for, and engage in life long learning;	3.76	3.94	3.84	3.50	3.80	3.87	3.78
10. Know contemporary issues;	3.76	3.82	3.84	3.50	3.70	3.83	3.74
11. Use techniques, skills and modern engineering tools necessary for engineering practice.	3.64	3.76	3.89	3.50	3.50	4.00	3.72
12. Know and understand engineering and management principles as a member and leader of a team, and to manage projects in a multidisciplinary environment; and,	3.76	3.76	3.89	3.25	3.80	3.87	3.72
13. Understand at least one specialized field of engineering practice.	3.80	3.88	3.89	3.75	3.80	3.93	3.84
Average	3.72	3.83	3.81	3.48	3.68	3.89	3.74



For the overall rating, it was observed that the Library & Information Science got the highest level of program outcomes attainment with a mean score of 4.00 while the Information Technology program got the lowest level of attainment with a mean score of 3.69. In terms of the program outcomes, the overall attainment rating is 3.89 which is attained. PO4*: Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles*; and PO6: *Apply computer science theory and software development fundamentals to produce computing-based solutions* got the highest mean scores of 3.72 while PO2: *Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline* got the lowest attainment rating of 3.88.

For Architecture, it was observed that the average numerical scores from the student respondents are all higher than 2 concurrently. PO2: *Effectively communicate orally and in writing using both English and Filipino;* PO13*: Participate in the generation of new knowledge*; and PO14: *Recognize the need for and engage in life-long learning* got the highest mean score of 3.75 while PO5: *Create architectural solutions by applying knowledge in history, theory, human behavior and environmental context*; PO4: *Function in multidisciplinary and multi-cultural teams*; PO5*: Identify, formulate, and solve engineering problems; and* PO9 *Prepare contract documents, technical reports and other legal documents used in architectural practice adhering to applicable laws, standards and regulations* got the lowest mean scores of 3.50. Hence it is concluded that each program outcome is satisfactorily attained at this point in time. Furthermore, it was also observed that the results are precise which validates that values indicate the actual extent of the attainment

In terms of the program outcomes, the overall attainment rating is 3.61 which is attained.

Table 1b Graduating Students Survey Results (Computer Studies)

Criterion	CS	IT	LIS	Total
No. of Respondents	8	65	1	74
1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions;	4.00	3.68	4.00	3.89
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline;	4.00	3.63	4.00	3.88
3. Communicate effectively in a variety of professional contexts;	4.00	3.71	4.00	3.90
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles;	4.00	3.72	4.00	3.91
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline; and,	3.88	3.66	4.00	3.85
6. Apply computer science theory and software development fundamentals to produce computing-based solutions.	4.00	3.72	4.00	3.91
Average	3.98	3.69	4.00	3.89

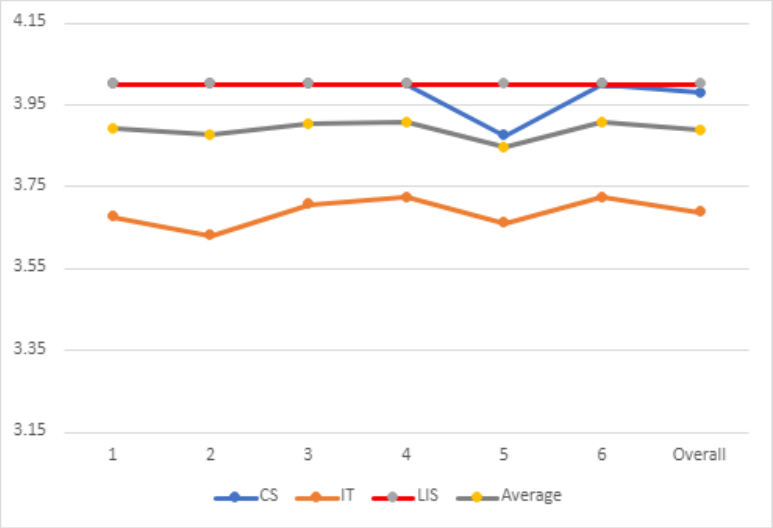
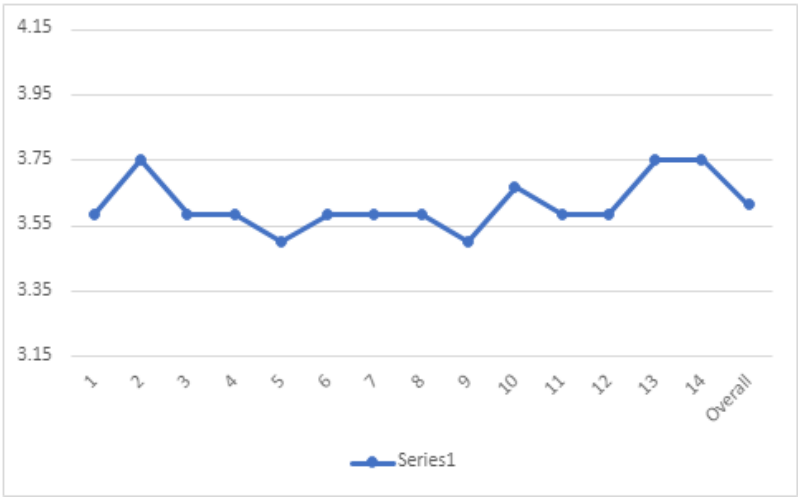


Table 1c Graduating Students Survey Results (Architecture)

Criterion	ARCH
No. of Respondents	12
1. Keep abreast with the developments in the field of architecture practice;	3.58
2. Effectively communicate orally and in writing using both English and Filipino;	3.75
3. Work effectively and independently in multi-disciplinary and multi-cultural teams;	3.58
4. Take cognizance of professional, social, and ethical responsibility;	3.58
5. Create architectural solutions by applying knowledge in history, theory, human behavior and environmental context;	3.50
6. Produce and present design solutions by applying architectural principles, programing, universal design, planning, building systems and professional practice;	3.58
7. Use of concepts and principles from specialized fields and allied disciplines into various architectural problems;	3.58
8. Use of various information and communication technology (ICT) media for architectural solutions, presentation, and techniques in design and construction;	3.58
9. Prepare contract documents, technical reports and other legal documents used in architectural practice adhering to applicable laws, standards and regulations;	3.50
10. Interpret and apply relevant laws, codes, charters and standards of architecture and the built environment;	3.67
11. Acquire of entrepreneurial and business acumen relevant to architecture practice;	3.58
12. Contribute in the management of the construction works and building administration;	3.58
13. Participate in the generation of new knowledge; and,	3.75
14. Recognize the need for and engage in life-long learning.	3.75
Average	3.61



IV. CONCLUSION

This paper shows how the assessment and evaluation of the program outcomes of Engineering, Computer Studies & Architecture programs of LPU Cavite can be systematically conducted. It was also identified from the result of student outcomes, areas that needs to be improved by the College.

As one can easily observe, the actual attainment levels far exceed the expected levels for each outcome across all programs under the College of Engineering, Computer Studies & Architecture of LPU Cavite. At this point in time, it can be said, that program outcomes with the lowest attainment rating are the areas that needs to be improved by the college towards effective implementation of the curriculum of the programs under the College.

In so doing, this paper documented step by step how the ABET expectation can be met so that various accreditation stakeholder might be able to prepare specifically for the critical stages and move forward towards continuous improvement.

REFERENCES

[1]. 1.ABETAnnualReport2008,http://www.abet.org/uploaded-Files/Publications/Annual_Report/abet-2008-annual-report.pdf , accessed May 2012.

[2]. ABETCriteriaforAccreditingEngineeringPrograms,2012–2013,http://abet.org/engineering-criteria-2012-2013/ , accessed May 2012.

[3]. K. Edwards, E. Fernandez, T. Milionis and D. Williamson, EAST: developing an electronic assessment and storage tool, *Assessment and Evaluation in Higher Education*, **27**, 2002, pp. 95-104.

[4]. R. Miller and B. Olds, An assessment matrix for evaluating engineering programs, *Journal of Engineering Education*, **87**, 1998, pp. 172–179.

[5]. N.Soundarajan,Programassessmentandprogramimprove- ment: closing the loop, *Assessment and Evaluation in Higher Education*, **29**, 2004, pp. 597–610.

[6]. ABET Self-Study Questionnaire (Engineering), http://abe- t.org/download-self-study-templates/, accessed May 2012. 7. D. Hokanson, L. Phillips and J. Mihelcic, Educating engineers in the sustainable futures model with a global perspec- tive: Education, research and diversity initiatives, *International Journal of Engineering Education*, **23**, 2007, pp. 254–265.

[7]. P.Ball,H.Grierson,K.J.Min,J.JackmanandP.Patterson, Working on an assignment with people you'll never meet! Case study on learning operations management in interna- tional teams, *International Journal of Engineering Education*, 23, 2007, pp. 368–377.

[8]. S.LudiandJ.Collofello,Ananalysisofthegapbetweenthe knowledge and skills learned in academic software engineering course projects and those required in real projects, *Proceedings of Frontiers in Education Conference*, Reno, NV, October 2001.

[9]. M. Oliver-Hoyo and D. Allen, The use of triangulation methods in qualitative educational research, *Journal of College Science Teaching*, **35**, 2006, pp. 42–47.

[10]. ABET Program Evaluator (PEV) Refresher Training Pro- gram in Module 4 at http://www.abet.org/pev-refresher-training-module4/ , accessed May 2012.

[11]. K. J. Min and W. Shi, Learning improvement in leadership, teamwork, and contemporary issues through a global supply chain project, *Proceedings of the ASEE Annual Conference*, Vancouver, Canada, June 2011.

[12]. J. Lohmann, Voice of experience, *ASEE Prism*, **7**, 1998, p. 124.