Journal of Engineering Science and Technology
Vol. 6, No. 5 (2011) 532 - 541

AN INTEGRATED PORTFOLIO AND ADVISING SYSTEM FOR UNDERGRADUATE ENGINEERING STUDENTS

MUSHTAK AL-ATABI, ABDULKAREEM SH. MAHDI AL-OBAIDI, OBAI YOUNIS*, EDWIN CHUNG

School of Engineering, Taylor's University, Taylor's Lakeside Campus,
No. 1 Jalan Taylor's, 47500, Subang Jaya, Selangor DE, Malaysia
*Corresponding Author: Obai.Younis@taylors.edu.my

Abstract

Portfolios are important tools to document the professional experience of engineers, architects and other professionals. When implementing the portfolios at undergraduate level, often the quality of the portfolios' entries and the frequency of their update by students are cited as obstacles. Other obstacles include the time consumed in assessing the portfolio and the timeliness of feedback given to students. To address these difficulties, an integrated Portfolio-and-Advising system was introduced at two modules offered at undergraduate engineering courses. The system requires the students to track the progress of their learning outcomes, provide documentary evidence to support claims of achievement of these learning outcomes and regularly meet their academic Advisors to seek feedback and validation of the achievement of the learning outcomes. This aimed at creating intentional learners out of these students as they take ownership of their academic progress. Feedback from both the students and the lecturers (Advisors) is very encouraging as both students and lectures agreed that the system provides a useful and comprehensive tool to track the achievement of the module's learning outcome.

Keywords: Portfolio, Educational Advisory System, Learning Outcomes, Engineering.

1. Introduction

Education institutions are increasingly confronted with the challenge of satisfying variety of stakeholders' requirements. While employers desire graduates who are equipped with technical and soft skills that will enable them to contribute with minimum training, students require a course that is engaging, not time demanding and takes into account their different learning styles. Governments and sponsors, on

the other hand, would like the education process to cater for the national priorities and take place with ever shrinking resources and limited funding. For professional courses, such as engineering, academic institutions need to maneuver all the above while adhering to strict quality assurance and accreditation requirements. This situation calls for an active and innovative approach to both curriculum design and delivery and assessment in order to achieve the different expectations.

This led to a transformation of engineering education from being teacher-centred to student-centred with initiatives such as project-based learning [1] and case-based learning [2]. The use of students' portfolios, which are widespread in art and architecture courses, is also being adapted for engineering courses (Panitz [3], Christy [4], and Mourtos [5]). To assist students in their academic encounters, institutions are assigning mentors or advisors to each undergraduate student. There is a concern about the effectiveness of using the portfolio at the undergraduate engineering programme as students do not like to update their portfolios and their entries and supporting evidences are often of poor quality.

This paper reports on the use of the Educational Advisory System (EASY) and the student's Portfolio in an integrated manner to help students track and achieve their course learning outcomes. This aimed at creating intentional learners out of the students as they take ownership of their academic progress while having the benefit of timely feedback from their Advisors on how to reach higher levels of achievement. The study includes the assessment by both students and lecturers of the effectiveness and usefulness of the method.

2. Case Background

Taylor's University developed the Taylor's Graduate Capabilities (TGC) (Taylor's Graduate Capabilities [6]), whereby graduates are inculcated with qualities and abilities that are sought after by employers in an approach that is consistent with the requirements of the Malaysian National Accreditation Board. TGC include discipline specific knowledge, cognitive capabilities and soft skills. These capabilities are systematically imbedded in the curricula developed for each educational programme.

In the case of the engineering programmes, most of the cognitive capabilities and the soft skills are imbedded in the learning outcomes of the project-based-learning Multidisciplinary Design modules which are offered in each semester. When a student join an engineering programme, (s)he is assigned an Educational Advisor who is a lecturer that will act as a point of reference for the students. The Advisors and the students are supposed to meet regularly to discuss any issues related to their studies. The students were asked to track the progress of the achievement of their learning outcomes in the Design Modules, provide evidence of the achievement, discuss that with their Advisors and get the advisors to verify the achievement of the learning outcomes. This is documented in a portfolio that carries 20% of the total mark of the Design Module.

3. The Design Modules

This integrated approach is used thus far for two modules "Engineering Design and Communication" offered in year 1 semester 1 (February 2010 Intake) and

"Engineering Design and Innovation" offered in year 1 semester 2 (September 2009 Intake). Each of these modules is offered to a combined class of chemical, electrical & electronic and mechanical engineering students in 14 week semesters. The learning outcomes for these modules are given in Tables 1 and 2 respectively.

Table 1. Learning outcomes of "Engineering Design and Communication" Module.

	Learning Outcomes
1.	Explain the social, cultural, global, ethical and environmental responsibilities of a professional engineer.
2.	Understand the importance of effective team working and be able to adopt team working strategies.
3.	Use reverse engineering to infer how a given device works.
4.	Describe the design process, including the concept of design constraints and the iterative nature of design, and recognise design in other disciplines.
5.	Critique different design ideas, comparing and evaluating them.
6.	Produce clear and accurate sketches and drawings (both manual and computer generated).
7.	Write effective technical reports and updated logbooks.
8.	Use appropriate visual communication techniques to communicate concepts and ideas.

Table 2. Learning outcomes of "Engineering Design and Innovation" Module.

	Learning Outcomes
1.	Apply and incorporate the technique of observation, ideation and prototyping as part of the design process.
2.	Understand the importance of business value in design and innovation and to be able to estimate them.
3.	Understand the importance of intellectual property rights as a legal instrument for commercial monopoly.
4.	Use appropriate communication techniques to communicate concepts and ideas.
5.	Be aware of the non-technical aspect related to commercialising a product.

In these modules, students are exposed to the principles of design, innovation and other professional skills through a series of lectures, seminars and discussion sessions while simultaneously working in multidisciplinary teams on fairly sophisticated projects under the supervision of a lecturer. The assessments of these two modules include submitting a working model (project), a written report, and a portfolio.

4. The Portfolio

Students need to meet their Advisors weekly during a timetabled slot. The advisor-advisee meetings during the first couple of weeks of the semester are spent in developing Strength, Weaknesses, Opportunities, and Threats analysis

(SWOT) [7] and writing a Mission Statement for the students. This period also serves as an ice breaking stage for the semester 1 students. Subsequently, students need to see their Advisors to seek comments and validations of the students' assessment of how they progressed in achieving the different learning outcomes. For each learning outcome, students need to assess whether their level is 1 (beginner), 2 (intermediate) or 3 (demonstrable) and provide a supporting evidence. The Advisor's role is to critique this and provide feedback on how to reach the next performance level. A typical record entry page is shown in Fig. 1.

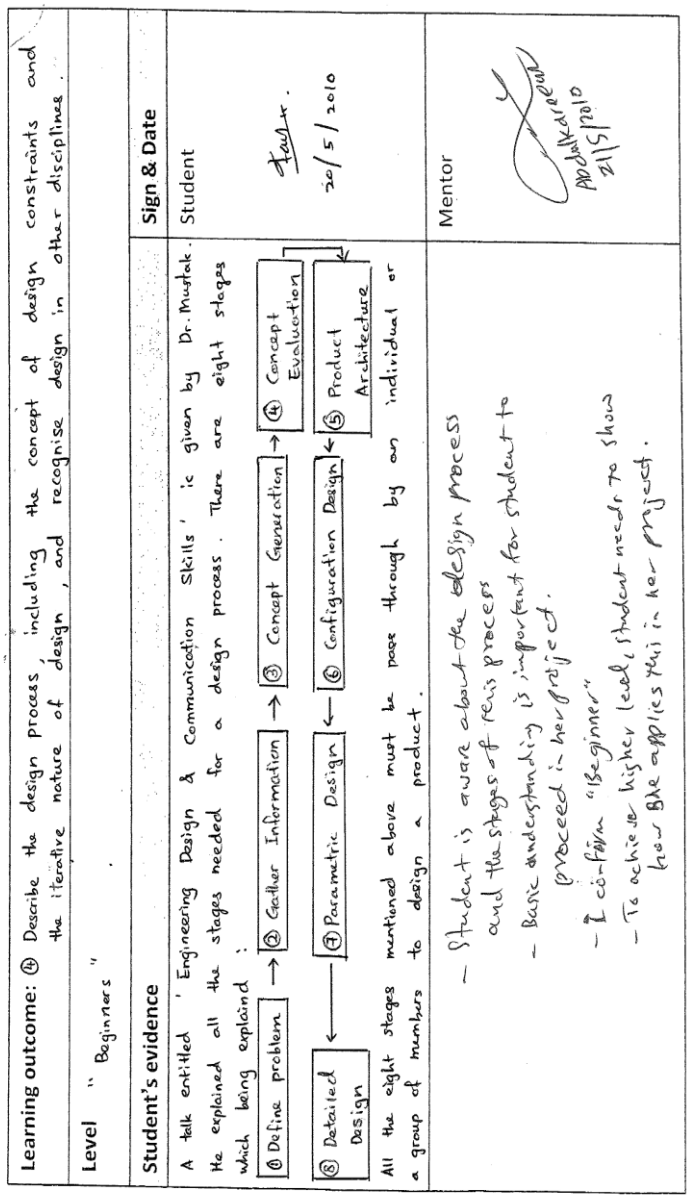


Fig. 1. Portfolio's Entry Page.

The portfolio provides a typical learning outcome achievement plan so that the students know what is expected from them by when. A typical learning outcome achievement plan is shown in Table 3. The portfolio also provides the Advisors and the students with a list of indicative evidences to look for to standardise what is expected when assessing the level of achievement of a given learning outcome. This is shown in Table 4.

Table 3. Typical Learning Outcome Achievement Plan.

	Level		
Learning Outcome	**1 (Beginner)**	**2 (Intermediate)**	**3 (Demonstrable)**
1	Week 4	Week 9	Week 13
2	Week 1	Week 3	Week 7
3	Week 5	Week 7	Week 9
4	Week 3	Week 5	Week 7
5	Week 5	Week 7	Week 10
6	Week 4	Week 8	Week 12
7	Week 6	Week 9	Week 12
8	Week 5	Week 8	Week 11

Table 4. Learning Outcomes Achievements look-fors.

Learning Outcome	Look Fors
1	Shows evidence of project planning. Gives examples of engineering ethical practices (preferably related to his/her project). Narrates examples on the importance of cultural & environmental issues in Design and relates that to his/her project. Understands the concept of industrial safety and cost estimation and shows evidences of using those in his/her project work
2	Describes the different stages of the team forming cycle and narrates descriptors from his/her team experience. Narrate examples where he/she contributed positively to team dynamics, resolved conflict, provides leadership, etc..
3	Describes reverse engineering and narrates examples where his/her team used reverse engineering
4	Clearly describes different stages of the Design Process and relate each stage to his/her design project.
5	Shows evidence (from his/her project work) that he/she has worked with different concepts and ideas to achieve the project objectives. Able to defend the choices and selections made and clearly identifies the compromises made to address different limitations.
6	Produces evidence (neat and clear sketches) both manual and computer generated that show fairly complex use of the drafting skills preferably in the context of his/her design project. This includes 3D drawings, dimensions and tables.
7	Clearly understands plagiarism and the importance of clearly citing the work of others Produces evidence (Report, Paper, etc..) that is clearly written in a technical context following the standard format accepted by engineering practice (abstract, TOC, Methodology, Results & Discussion, Conclusions, References, Appendices) . This should show evidence of referencing cited materials, use of consistent fonts and sizes, clear graphs with descriptive captions, page numbering, etc...
8	Shows evidence of clear and effective presentation skills including the use of Power Point and other multimedia tools. The evidence could be a video taken of the student while presenting or the mentor to attend one of the student's presentations, etc...

5. Research Methodology

5.1. Participants

The participants were 125 undergraduate students (year 1, semester 1) enrolled for the Engineering Design and Communication, 61 undergraduate students (year 2, semester 2) enrolled for the Engineering Design and Innovation and 17 lecturers. The participants were from Chemical, Electrical & Electronic and Mechanical engineering programmes. The students' sample (the entire cohort of students) consisted of 147 males and 39 females, with an average age of 18 years (ranging from 17 to 23 years). 90% of the students were locals from Malaysia while the rest were international students.

5.2. Procedures and Measurement

At the end of the semester, students and Advisors were asked to complete two different surveys that were aimed at evaluating how both the students and the Advisors perceived the effectiveness of the integrated portfolio an advising system. The surveys were designed to measure how useful, easy to use and time effective the system was. Students also were asked if they would opt to have a portfolio next semester and lecturers were asked if they would volunteer again to be advisors.

The students' survey included the following statements:

1. The portfolio is a very useful tool to track my learning progress.
2. The portfolio is an easy to use document &updating it was easy.
3. Updating the portfolio was time consuming.
4. The time spent on updating the portfolio was a wise investment.
5. I received adequate support from my lecturers and Advisor.
6. If given the choice, I shall opt for having a portfolio next semester.
7. I regularly updated my portfolio.
8. I regularly attended meetings with my Advisor.
9. Overall, having a portfolio was a great experience.

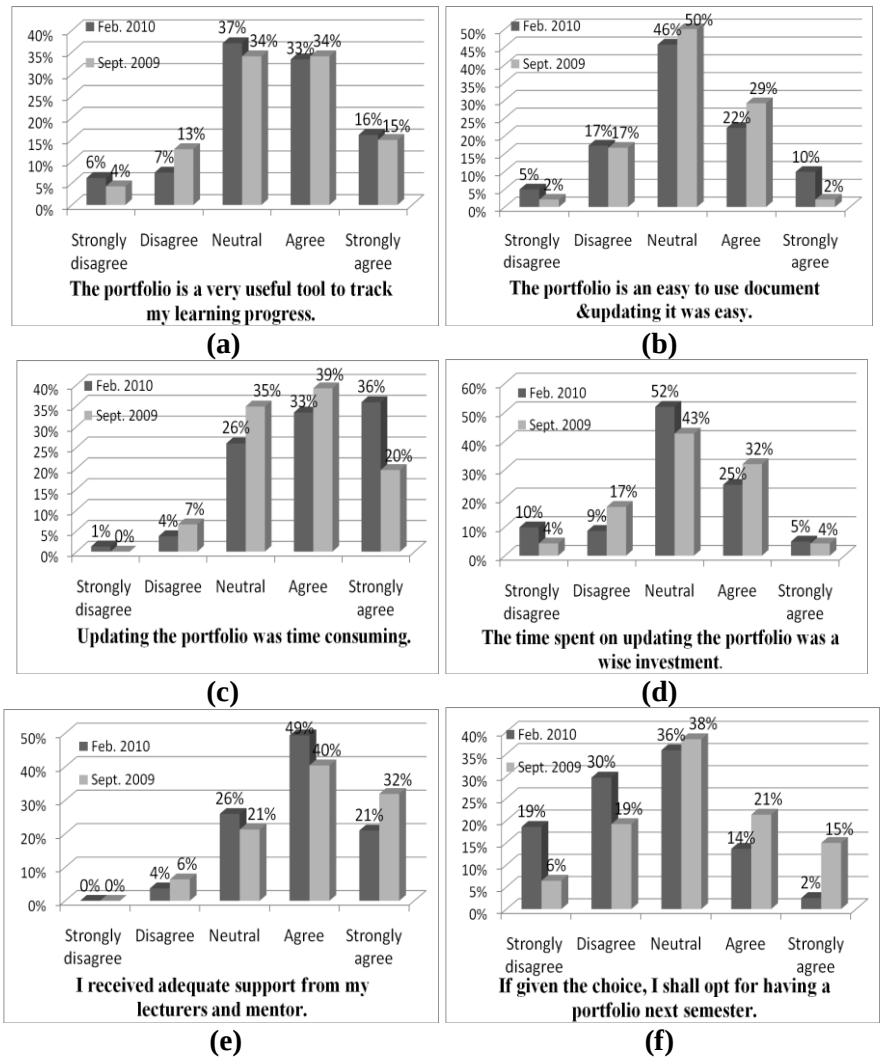
The lecturers' survey, on the other hand, included the following statements:

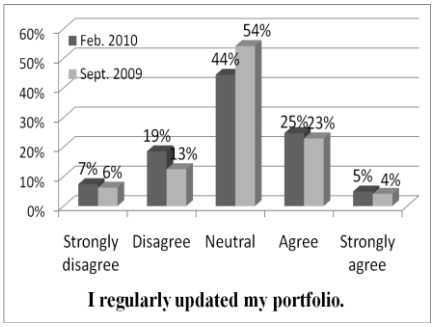
1. The purpose of having regular meetings with my Advisees and commenting on their Portfolios is clear to me.
2. The expectations of achievements of different learning outcomes were clear to me.
3. I have regularly commented on my Advisees' entries in a written form by filling the Lecturer's section.
4. The system is a good investment of both my time and the students' time.
5. The allocated time was adequate.
6. The portfolio is a useful tool to track the progress of achieving learning outcomes.
7. It would be useful to extend the Portfolio to other subjects (besides the Design subject).
8. Meeting the students strengthens the relationship between the lecturers and the students.
9. I like my experience of being an Advisor and would volunteer again as an Advisor.

All respondents were requested to rate their agreement level with the statements in their respective survey on a five-point Likert-type scale [8].

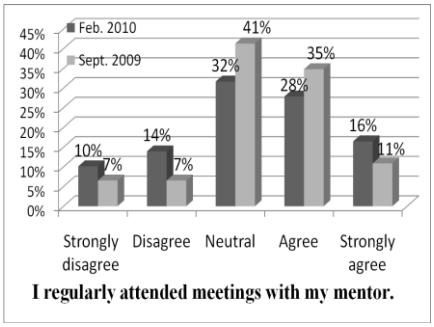
6. Results and Discussion

Figure 2 shows the overall responses from the students. Generally speaking students from both cohorts either did not mind having the Portfolio or found it to be a useful and easy to use tool. Although majority of the respondents found updating the Portfolio to be a time consuming exercise (Fig. 2c), they agreed that it was a wise time investment (Fig. 2d). Students were satisfied with the level of support rendered by the faculty (Fig. 2e). Interestingly, 36% of the second semester students (having been through the same experience twice), indicated that they will opt for having a Portfolio next semester if they are given an option. Only 16% of the first semester students opted for the same (Fig. 2f). This is an assuring trend indicating that as the students go through the experience more they get to appreciate its usefulness.

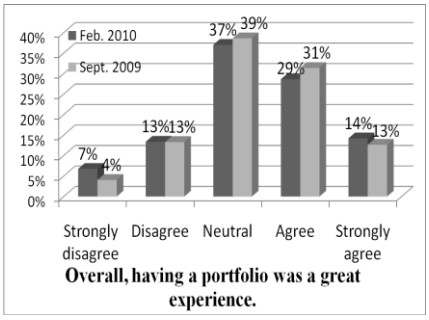




(g)



(h)



(i)

Fig. 2. Summary of the Students' Responses.

The summary of the lecturers' responses are given in Fig. 3. Majority of the lecturers (Advisors) indicated that they understood the system, its importance and their role in its success (Fig. 3a). They found the system to be useful and recommended extending it to other subjects (besides the Design module). They also indicated that the time allocated in the time table to meet the students was not sufficient (Fig. 3a).

The above results highlighted 2 main concerns. These are the percentages of students opting to continue using the Portfolio (Fig. 4f) and lecturers (Advisors) were not allotted sufficient time to meet with their mentees (Fig. 5e). The results captured in Fig. 4e indicates that students gain appreciation of the usefulness of the Portfolio through repeated exposure and it is felt that these percentages will increase as student progress through the semester. Our analysis of the students' Portfolio also indicates that majority of these students have difficulties organizing their evidence and lack the ability to write reflective journal. Sharing sessions to address this is planned in the hope that more students will appreciate the importance of portfolio even more.

As for the time allotted to lecturers (Advisors), we are planning to abandon the system where a student stays with a particular Advisor for the duration of his/her enrolment with the programme to one where the project supervisor is automatically assigned as the student's Advisor. This change should cut down the amount of time Advisors' spent trying to understand their student project work as it would have been clear during their project meeting.

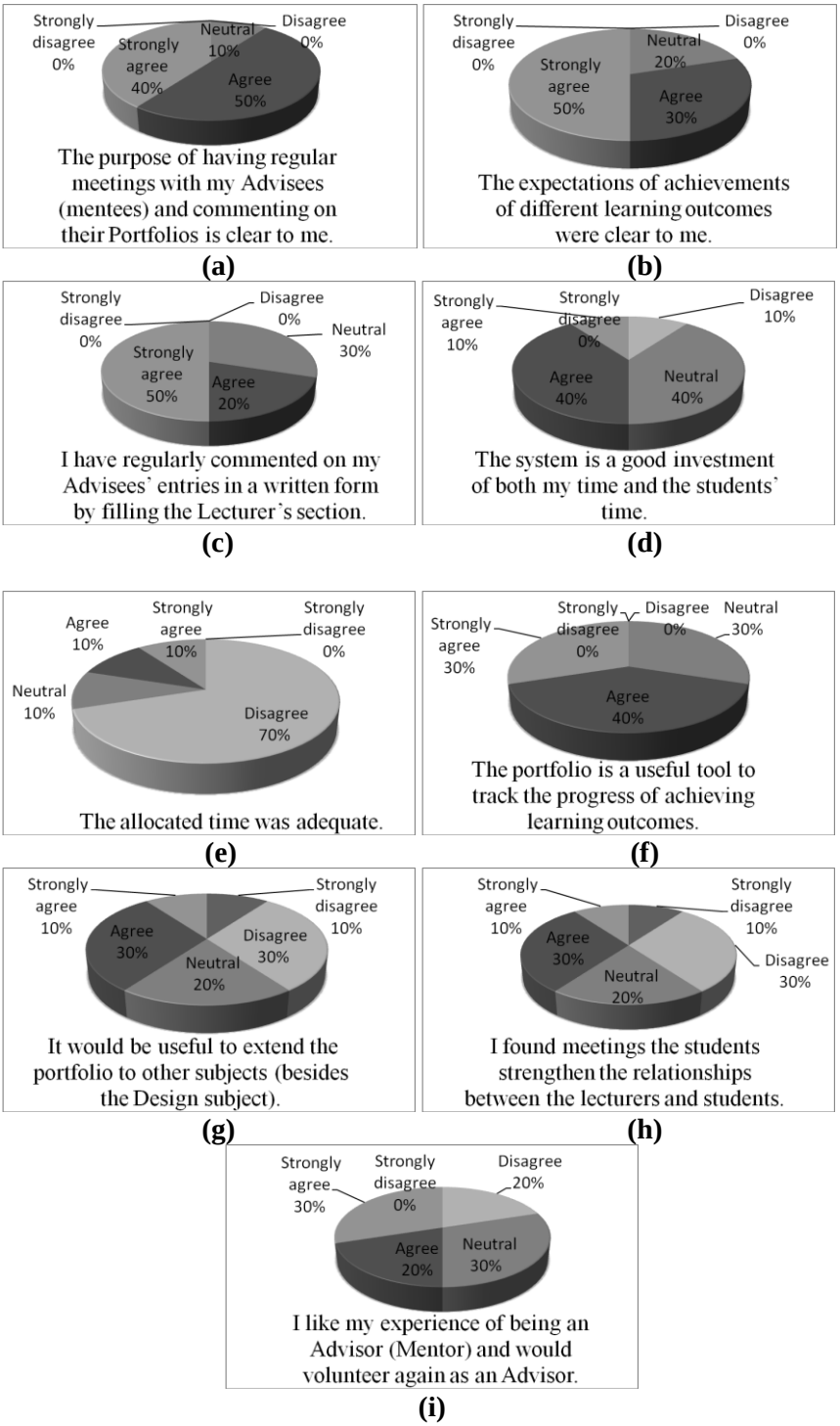


Fig. 3. Summary of the Lecturers' Responses.

7. Conclusions

An integrated Portfolio-and-Advising system was introduced at two modules offered at undergraduate engineering courses. The system requires the students to track the progress of their learning outcomes, provide documentary evidence to support claims of achievement of these learning outcomes and regularly meet their academic Advisors to seek feedback and validation of the achievement of the learning outcomes. This aimed at creating intentional learners out of the students as they take ownership of their academic progress.

After implementing this system for two semesters, feedback from both the students and the lecturers (Advisors) is very encouraging. Both students and lectures agreed that the system provides a useful and comprehensive tool to track the achievement of the module's learning outcome.

We intend to continue using the system and we plan to create an ePortfolio to facilitate the interaction between the students and their advisors.

References

1. Al-Atabi, M.T.; and Chin, S.B. (1997). A case study in project-based learning using flow visualisation. *Journal of Engineering Science & Technology* (*JESTEC*), 2(3), 290-297.
2. Al-Atabi, M.T.; and Chung, E. (2010). Case-based learning in engineering labs. *Proceedings of the 6th International CDIO Conference*, École Polytechnique de Montréal, Québec, Canada, June 15-18.
3. Panitz, B. (1996). The student portfolio: A powerful assessment tool. *ASEE Prism*, 5(7), 24-29.
4. Christy, A.D.; and Lima, M. (1998). The use of student portfolios in engineering instruction. *Journal of Engineering Education*, 87(2), 143-148.
5. Mourtos, N.J. (1999). Portfolio assessment in aerodynamics. *Journal of Engineering Education*, 88(2), 223-229.
6. Taylor's Graduate Capabilities (2009). TUC document TUC-ACA-SOPP-0002. *Appendix 1* (TUC document TUC-ACA-SOPP-0003) section 1 details TGC. From http://portals.taylors.edu.my/portal/ep/channelView.do? channelId=-12822&displayPage=/ep/channel/default_attachment_view.jsp&pageTypeId =12123.
7. Bensoussan, B.E.; and Fleisher, G.S. (2008). *Analysis without paralysis:* 10 *tools to make better strategic decisions*. Upper Saddle River, New Jersey, Pearson Education.
8. McIver, J.P.; and Carmines, E.G. (1981). *Unidimensional scaling:* (*Quantitative Applications in the Social Sciences*). Newbury Park, California, Sage Publications, Inc.