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Soft Skills in the Development of Team-Based Electronic Learning Portfolio

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Abstract

The top qualities of an effective engineer include not only technical competence but also soft skills which may be hard to acquire while already on the job. Fulfilling stakeholders' demand, educators design the curriculum for engineering programs with the objectives of producing graduates capable in not only technical competence but also possess the equally important soft skills. This calls for a good variety of assessment techniques of student learning in order to ensure a more comprehensive measurement of performance. With the limitations of the traditional pen and paper assessment approach, the electronic learning portfolio is one alternative that is integrated in the assessment of Differential Equations course in Universiti Teknologi PETRONAS, Malaysia. Two hundred and forty two engineering undergraduates are involved in the study and are randomly grouped into fifty one teams to develop team-based electronic Differential Equations Learning Portfolio, acronym e-DELP. In the process of developing the portfolio electronically, each team strategizes collectively in conformance to the criteria explicitly transcribed on the course e-learning portal. Objectively, e-DELP development creates a platform that provides participants the opportunity to exercise their soft skills while exploring the applications of Differential Equations in the real world and new skills in using Equation Editor and Power Point Presentation Skills. The participants' major task is to design a learning portfolio, team-based and problem-based within 7 weeks of a fourteen-week semester. The deliverable is a four-component learning portfolio, comprising members' demographic details, solutions to five modelling problems involving Ordinary Differential Equations, their evaluation of the course and delivery, and reflections of their learning experience; electronic-based and saved on a compact disc. A questionnaire is employed to measure the general attitude towards the integration of e-DELP, and individual interview sessions are conducted to further confirm the data obtained. The objective of this paper is to present some qualitative findings of the soft skills that participants acquire through the process of working on e-DELP, retrieved from the verbatim written comments in their evaluation and reflections, verbal and non-verbal feedback during the interviews. The results indicate that there is more to the learning than just skills in solving Ordinary Differential Equations which are of great value in the preparation of the future well-rounded engineers.

© 2010 Elsevier Ltd. Open access under [CC BY-NC-ND license](http://creativecommons.org/licenses/by-nc-nd/3.0/).**Keywords:** Electronic learning portfolio; Engineering; Soft skills; Qualitative

1. Introduction

The undergraduate and postgraduate programs offered at Universiti Teknologi PETRONAS or UTP a wholly owned subsidiary of PETRONAS, Malaysia's Oil and Gas Company, is focused on engineering and technology, with the

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mission of producing well-rounded graduates defined typically with the seven attributes as noted by A.Mohd Shariff et al (2000), that is, technical competence, lifetime learning capacity, critical thinking, communication and behavioural skills, business acumen, practical aptitude, and solution synthesis ability.

Chapman (2006) noted on Bloom's 'Taxonomy of Educational Objectives' which defines three learning domains: Cognitive, Affective and Psychomotor Domains. The Cognitive Domain involves intellectual capability i.e. knowledge, whilst the Affective Domain involves feelings, emotions and behaviour i.e. attitude, and Psychomotor Domain involves manual and physical skills. Hence, appropriate tools to measure engineering undergraduates' knowledge skills and attitude require more than just the traditional pen and paper. The Engineering School Directory (2010) listed the top ten qualities of an engineer as follows: (1) Possesses a strong analytical aptitude (2) Shows an attention to detail (3) Have excellent communication skills (4) Takes part in continuing education (5) Is creative (6) Shows an ability to think logically (7) Is mathematically inclined (8) Has good problem solving skills (9) Is a team player (10) Has excellent technical knowledge. Clearly, becoming an engineer is not all about acquiring technical skills but soft skills are as important.

How does an engineer acquire those non-technical skills? Kumar and Kent Hsio (2007) noted that currently, engineers learn leadership and management skills while working, and that certainly is learning "soft skills the hard way." It would be much easier for these engineers if they had been trained much earlier, i.e. by learning these skills at the tertiary level before being employed on the job. Engineering programs curriculum at institutions of higher learning is now designed to embed alternative instruments that could appropriately measure the desired soft skills. The paper and pencil type of assessment with its limitations is not able to measure communication skills, teamwork skills, organization and managerial skills, and other soft skills required in the making of an efficient engineer. As a result, educators resort to other options that could provide a more comprehensive measure of learners' performance. Aurbach and Associates (2010) noted the definition of the alternative assessment in Vision (1993) as "The utilization of non-traditional approaches in judging student performance", providing portfolio as an example, which is defined as "A purposeful collection of student work that exhibits the student's efforts, progress and achievements in one or more areas. The collection must include student participation in selecting the contents, the criteria for selection, the criteria for judging merit and evidence of student self-reflection." The learning portfolio comes in paper-based, or now electronic or web-based. According to Batson (2002), since the mid-90s, the term "e-Portfolio" or "electronic portfolio" has been used to describe collections of student work at a Web site. Barrett (2004) distinguishes the difference between the Electronic Portfolios and Online Assessment Management Systems; With regards to purpose, the e-Portfolio is for multiple purposes, i.e. for Learning, Assessment, and Employment, whilst the purpose of the Assessment Management System is for a single purpose, i.e. for Formative and Summative Assessment. Love et al (2004) defined e-portfolios as information that resides on a CD ROM or other physical media. The National Learning Infrastructure Initiative or NLII (2004) defined the portfolios as "collections of work designed for a specific objective-that is, to provide a record of accomplishments".

The large student number and the limitations of the pen and paper assessment approach are the motivation factors that lead the instructor to resort to implementing a team-based electronic learning portfolio. The electronic learning portfolio done in this study is intended to discover the soft skills that participants learn to acquire besides providing participants the opportunity to collectively work as a team, explore the use of differential equations in real life situations and at the same time apply their skills of solving first order differential equations that was taught in the first few weeks of the July 2009 semester. What do these undergraduates feel about such an experience? The focus of this paper is to discuss the students view and reflections of students' learning experience of doing the team-based electronic portfolio in the learning of Differential Equations. The objective, of this study is to capture and assess participants' feelings and attitude towards the development of the electronic Differential Equations Learning Portfolio, acronym e-DELP. The implementation of the team-based e-DELP in the assessment of mathematics for the engineering undergraduates in UTP is a new experience.

2. Methodology

The formation of this group of participants was predetermined by the program of choice by the participants and not manipulated. Two hundred and forty-two engineering undergraduates of July 2009 (first) semester, mainly from the Petroleum Geosciences, Mechanical, and Petroleum engineering undergraduates involved in this study were teamed

up into groups of four, five or six by random sampling, hence creating working groups consisting of unfamiliar associates of different backgrounds; gender, race, nationalities and culture. The majority of participants comprised mainly the multi-ethnic Malaysian locals, while the minority were Egyptian, Sudanese, Indonesian, Turkmen, Uzbek, South African, Burmese, and Cambodian. Data gathering was via several means; e-DELP, a self developed 8-item questionnaire, an interview, researcher's observation and field notes. For the purpose of this paper the focus will be the qualitative data that was obtained. At the onset of the semester, the instructor presented and clarified details of the expectations of the course and its delivery. Written quizzes and tutorials regarding first order Differential Equations are carried out to enhance students' understanding of the course materials prior to the prescribed e-DELP. The e-DELP will be evaluated as part of the coursework, contributing 10% of the course evaluation. Implementation of e-DELP was in the fifth week of the semester and deadline was the end of week twelve, thus providing a time frame of seven weeks for the completion and submission of e-DELP. A criterion-based scoring rubric was developed online by RubiStar (2009) and used to evaluate each deliverable. Participants expressed their feelings in writing, included in an "evaluation" and "reflection" component. The "evaluation" component allows participants to express their thoughts and comments on the strengths and weaknesses of the course and its delivery and propose suggestions for any improvement, while the "reflection" component provides participants the opportunity of expressing their feelings by responding to the questions; Is doing e-portfolio something beneficial for you? Why? How? This paper will focus on the findings based on verbatim responses. During the final week of the semester, a self-developed 8-item questionnaire shown in Table 1 was employed focusing on measuring the general opinion of the participants towards the implementation of e-DELP. Responses were based on the Likert scale of 5 for 'strongly agreed', 4 for 'agree', 3 for 'neutral', 2 for 'disagree', and 1 for 'strongly disagree'. Tested for its reliability, the questionnaire recorded its Cronbach alpha's reliability coefficient of 0.8259, with reliability item alpha value of 0.8279, suggesting that it is reliable.

Table 1. The 8-Items in the Questionnaire

Items	Statements
1	I learnt a lot from doing e-portfolio assessment.
2	I enjoyed doing DE modelling problems for e-portfolio assessment.
3	The Problem-Based Learning in e-portfolio assessment is an excellent idea.
4	The teamwork in my e-portfolio project group is excellent.
5	The instructions provided in doing the e-portfolio Assessment in DE is excellent.
6	I have definitely benefited from e-portfolio assessment in my learning of DE.
7	Overall, I am satisfied with the way my DE learning is assessed (using e-portfolio).
8	Overall, with e-portfolio I have enjoyed learning the DE course.

The interview sessions were all conducted on a one-to-one basis, with the consent of each individual involved. It was held in week thirteen and fourteen of the semester. Participants respond verbally in the interview that required participants to respond to the questions; Is this e-portfolio assessment a new experience to you? What do you think of this type of assessment? How did you like doing e-portfolio? What kind of skills do you think you have acquired while doing e-portfolio? Would you have preferred doing it individually? If asked to provide a rating for this type of assessment, in terms of its implementation and what you have experienced, out of a full score of 4 for the best, 0 for the worst, how would you rate it? What would be your suggestions for future improvement of this e-portfolio assessment?

During the interviews, the instructor also observed participants' non-verbal expressions; the facial expression, body language, and mood. Analysis of the data obtained from the interviews will be a holistic interpretation. The following observations of the participants' common behaviours; body language and non-verbal communication, i.e. facial expression, posture, gestures, sitting posture, eye contact, and voice.

3. Findings

Two hundred and thirty two participants responded to the questionnaire. It was found that all items in the questionnaire earned mean scores of over 4.2 out of a full score of five, with standard deviation not more than 1, indicating a normal distribution. Item 2 which referred to "I enjoyed doing DE modelling problems for e-portfolio

assessment” although recorded the lowest mean score of 4.2543 over 5.00, with standard deviation of 0.66739, indicating that most participants’ were of this opinion. The item 4, which referred to “The teamwork in my e-portfolio project group is excellent”, has the highest mean score of 4.5388, with a standard deviation of 0.63672, also indicating that most of the participants shared this opinion. This indicates that participants favoured the e-DELP assessment integration.

A total of fifty one teams were formed; twenty-one for the Mechanical Engineering, (ME1-ME21) and thirty for the Geosciences and Petroleum Engineering combined, (PEG1-PEG30). No late submissions were recorded, i.e. all groups managed to meet the targeted deadline. In this study, the findings were focused on the qualitative data obtained from the written feedback from participants in the “evaluation” and “reflections” components, and an interview that was conducted for clarification of the written responses. Data gathered from the interview provided verbal and non-verbal behaviour. For this paper, a total of ten teams were randomly selected for the analysis of results.

3.1 Evaluation

Some of the captions pertaining to strengths obtained from the “Evaluation of Course and Delivery” were tabulated as shown in Tables 2 and 3, focusing on its strength and suggestions for improvement, respectively.

Table 2. Written Responses towards Strength in Evaluation of Course and Delivery

Strength	
ME2	The materials used in this course; the workbook, the textbook and also the lecturer’s notes given are very useful for students and are complete.
PEG25	Differential Equation is a very challenging course, however through a very interesting approach by the lecturer, the process of learning become very fun and enjoyable. The lecturer always reminds us to read the topic ahead before we enter the class so that we already have the main idea about the topic that will be thought as our lecturer said, ‘It will make a world of difference’ and yes it is true.
ME4	I find that this course is rather interesting and fun. The good point about this course is the workbook used. The workbook is simple and guide students step-by-step. The instructions and delivery are good.
PEG6	Although the subject is quiet tough (yes, my first impression is right), the learning styles that are different from other mathematics subject, is really helping me. The reminder from lecturer that we should read first whatever that is going to be taught next class, is a main factor why I can absorb easily all the learning. The usage of the books that are written by the lecturer is also a factor why the delivery is such an effective.
ME5	In conclusion, differential equation lecture is the lecture that is always being awaited by me because the lecture is enjoyable and exciting.
ME11	I think this course has a vital and crucial contribution to for future because everything that we have learnt and going to learn is directly related to engineering and it is very important for a good engineer to be good at differential equations. Course delivery is very good.
PEG29	We found it very helpful when students are called to solve problems in front of the class and discussion is done afterwards. This method prepares each and every student before each lecture because they are being called randomly. Step by step instructions given by the lecturer are very understandable and provide the students with a period of time for understanding before the lecturer carries on to the next step. Besides, giving constant pop up quizzes before or after lectures enable students to pay attention during each lecture and most importantly attend every lecture.

Table 3. Written Responses towards Suggestions for Improvement in Evaluation of Course and Delivery

Suggestions for Improvement	
ME9	We want to suggest to her to extend the tutorial class to become two hour session. This is because the one hour session is too short and we found that this class is very beneficial to us to understanding this subject

- PEG6 In my opinion, about 120 students packed together to learn one of the toughest subject this semester, is not a very good idea. Sometimes it is quiet hard to concentrate when the number of students are too many. We should reduce the number of students during the lecture.
- PEG13 Our main gripe is that the final exam carries 60% of the total course mark. We find it to be a tad too high and that 50% is a more reasonable option.
- PEG18 I hope that the learning process would be better experience if the students are exposed to application of this subject to the industry, perhaps by visits to the related sites.
- ME11 Suggestions that I wanted to make are regarding tutorials. It was a bit hard for me to concentrate in tutorials this semester because the tempo that has been set was too fast for me. I could not really follow all exercises or copy them even though I solved most of them in my room.
- ME15 First of all, the lecturer must make sure the pace of teaching is suitable for most students, if not all. Next, more exercises and examples need to be done in class to improve the students' understanding.
- PEG30 The course can be improved by providing students with not only text books and work books but also lecture slides where the steps of each solution are explained more detailed. Besides, it would be great if after each sub topics students are given the opportunity to try out on examples before the lecturer carries on to the next topic.

3.2 Reflections

Table 4 indicates participants' responses to the question; Is doing e-portfolio something beneficial for you? Why? How?

Table 4. Written Responses towards Reflections of Learning Experience

<u>Is doing e-portfolio something beneficial to you? Why? How?</u>	
ME2	This e-portfolio is very beneficial to us because it is through this assignment that we fully understand the concept of Differential Equations. To improve our learning experience, we think that more of this assignment should be implemented into the syllabus not only for this course but other courses as well.
ME4	This E-portfolio is very good for me. It actually made me open and explore the textbook.(e-portfolio is beneficial) Doing this E-portfolio has made me realized that daily problems can be easily solved using basic differential equations concepts.(e-portfolio made me see applications of Differential equations)
PEG6	Definitely yes! By doing this portfolio, we can help each other in solving the question. If we could not solve a question by our own, we still have other members who might be able to assist us. Besides, we also make new friends through this portfolio. We are grouped randomly by our lecturer so that we will not only stick with our own clique. A group of five members who belong to different sex, religion and races make us understand our nation better.
PEG4	E-portfolio is something beneficial to us because it helps us to get better understanding about applications base on the topics that we have learnt in Differential Equations course. It also teaches and trains us to work together and manage to finish the project in group even though we don't know who our partners are before. So that, in the future when we work, we will be easy to work together with people who we don't know because we get used to it. This e-portfolio project also has been beneficial in the sense that it has helped us improve our team building, communication and teaching skills by helping one another in problematic areas and working together towards a common goal. Besides that, e-portfolio enables us to express our creativities by creating the PowerPoint slides beautifully base on our own creativity. For someone who has little or no understanding on the differential equations we addressed; a presentation of this project (the step by step instructions on how to solve specific problems) would definitely improve their understanding on Differential Equations.
ME5	Making this e-portfolio has educated us. It is beneficial because we can develop our teamwork among the team members, getting to know each other and also help to improve our skills on solving DE by discussing together the questions. Everybody in the group has been equal contributions toward this assignment. In fact, we don't see this e-portfolio as an assignment but actually as an improvement in an educational and self aspect.
ME11	Yes, the portfolio is very beneficial to us as Differential Equation is the basic or the foundation platform to

solve every mathematical problem in our life. Firstly, it was tough and we have to burn midnight oil to solve the question given. We had meetings regularly and finally we can solve all the questions in a short period of time. Then, we would like to mention that we enjoyed working in group and have developed and improved some other skills like communication, punctuality, teamwork and etc.

PEG29 Doing this E-Portfolio provides students a chance to present their solution in Differential Equation problems in a creative way such as by using Microsoft Power Point. This indicates that this project is indeed beneficial for all students. Apart from that, this E-Portfolio also compiles the different ways of solutions for different questions. This is because not all groups doing this E-Portfolio use the same way to overcome the similar question. Thus, this allows the students to acknowledge other methods in solving the questions. Furthermore, students also can relate some of the daily activities problems with the solution that we learn in this course. Some of students have a perception that what we learn in Differential Equation will not be applied in our work in the future but after completing this E-Portfolio, their perception towards this course hand changed because this course is also related to our daily life, no matter what position we hold in the future.

3.3 Interview

Two hundred and forty two participants were individually interviewed, on a one-to-one basis. One hundred and twenty three of these were captured on video, with consent, while the rest preferred to be interviewed without it. Through the observations by the researcher, it was noted that generally, participants seemed quite relax, with calm facial expressions and many with smiles indicating pleasure. Eye contacts were good and participants conversed well in English with clear and steady voice indicating comfort, confidence and no signs of fear or threatened.

The findings indicate that with the exception of only 1.2% of the participants, the e-portfolio was a first time experience. None of the participants agreed to the suggestion of doing e-portfolio individually-based. Participants claimed that their understanding of the course was much better as they were able to see how Differential Equations were put into applications while solving the modelling problems. For further improvement, participants' suggestions were to have both individual and group interviews and in-class presentations.

Table 5 shows some of the skills that participants felt that they have learnt while involved in the development of e-DELP.

Table 5. Examples of soft skills acquired in the Development of e-DELP given during interviews.

Skills	Activities
Leadership Managerial	Delegation of work, conduct group meetings, ensuring deliverable is completed and submitted on time.
Communication Teamwork	Liaison with team members, organization and arrangement of materials in order Interaction with new peers from different backgrounds, nationality and culture,
Writing	teaching/explaining to peers with difficulties in understanding given problems.
Critical thinking Decision making	Completion of the evaluation and reflections, making decisions of which material should be included. Solving the problems, commenting on the evaluation of course and delivery, making suggestions for improvement.
Computer	Using Equation Editor, Power Point Presentation utilising animation and incorporating sound effects.
Social	Making new friends, and discovering and learning to know and understand other people better.
Research	Discovering from resources, books, internet and friends the appropriate models to use in order to solve the problems.

Some skills acquired included the ability to do research work in looking for an appropriate model for five application problems, competency in using Microsoft Equation Editor to write mathematical equations and utilizing the animation effects on Microsoft Power Point Presentation, teamwork, social, communication, critical thinking, writing skills, management and leadership skills.

During the interview, participants were asked about their rating of the e-DELP in terms of its implementation and the newly acquired skills obtained in the development process. The statistical analysis of participants rating of the team-based e-DELP implementation indicates that of the full score of 4, the mode is 4, with mean score of 3.65, and the median or central score 3.75. The variance of 0.161 suggested that the participants' feeling about the rating of 3.65 was well agreed upon amongst themselves. In other words, participants favoured the development of e-DELP and its implementation as an integral part of their course evaluation. When asked if the participants would have preferred individual-based e-DELP and the answer was unanimous "not favourable".

4. Discussion and summary

The study shows that the e-DELP was highly acceptable amongst the two hundred and forty two engineering undergraduates of UTP. They mentioned having fun doing the course, and were satisfied with the way the course was delivered and the materials used. The e-portfolio implementation was to the participants' satisfaction. It should be noted that the e-DELP was team-based and participants would not have favoured it on individual basis. While developing the e-portfolio, the participants were able to set aside their differences and worked towards achieving their goal together. Research culture was also instilled since the work required them to resort to various resources in search of information. The abilities of gathering information from all team members, organizing, coordinating, arranging and presenting all input on the compact disc and delivering it on time certainly demonstrated their soft skills. The data obtained from various approaches; the questionnaire, written evaluation and reflections of learning, the rating, verbal and non-verbal communication during the interviews were all in favour of such assessment method. The soft skills that participants have demonstrated; leadership, managerial, communication, teamwork, writing, critical thinking, decision making, computer and research could not have been discovered via the traditional method as what was shown with this alternative approach.

5. Recommendation

The study was limited to engineering students on UTP grounds only. For future work, this study could further be extended to other programs and on other campuses as well. The researcher will also consider conducting in-class presentations and group interviews as suggested by the participants in this study.

References

- A. Mohd Shariff, M.I. Abdul Mutalib and M.H. Ahmad Fadzil, (2000). *Students Industrial Internship Programme at Universiti Teknologi PETRONAS (UTP), Malaysia*. Retrieved August 20, 2010 from <http://www.ineer.org/events/icee2000/proceedings/papers/WC7-4.pdf>
- Aurbach & Associates, Inc. (2010) *About Alternative Assessment*, Retrieved August 20, 2010 from http://www.aurbach.com/alt_assess.html.
- Barrett, H (2004). *Differentiating between the Electronic Portfolios and Online Assessment Management Systems*, Retrieved August 19, 2010 from <http://www.electronicportfolios.org/portfolios/SITE2004paper.pdf>.
- Chapman, A., (2006). *Bloom's Taxonomy of Learning Domain*. Retrieved on August, 20, 2010 from <http://www.businessballs.com/bloomstaxonomyoflearningdomains.htm>
- Love, D., McKean, G., Gathercoal P., (2004). *Portfolios to Webfolios and Beyond: Levels of Maturation*. Retrieved December 10, 2004 from <http://www.educause.edu/pub/eq/eqm04/eqm0423.asp>.
- National Learning Infrastructure Initiative, (2004). *Definition and Importance of ePortfolios*. Retrieved December 10, 2004 from <http://www.educause.edu/ElectronicPortfolios/2600>.
- QS Top universities, *Universiti Teknologi PETRONAS*, Retrieved August 20, 2010 from <http://www.topuniversities.com/university/4797/universiti-teknologi-petronas->
- RubiStar, "Create Rubrics for your Project-Based Learning Activities." Powered by 4Teachers.org, ALTEC2006, the University of Kansas, , Retrieved May 27, 2009 from <http://www.4teachers.org/tecalong/erica4/>.
- Sanjeev Kumar & Kent Hsio, J. (2007), Engineers Learn "Soft Skills the Hard Way": Planting a Seed of Leadership in Engineering Classes, *Leadersh. Manage. Eng. Volume 7, Issue 1*, pp. 18-23.
- The Engineering School Directory, "Top 10 Qualities of a Great Engineer", Retrieved June 1, 2010 from <http://www.engineeringschools.com/engineering-top-10.html>.
- Trent Batson (2002). *The Electronic Portfolio Boom: What's it All About?* Campus Technology, Retrieved on August 19, 2010 from http://www.msnc.la.edu/include/learning_resources/emerging_technologies/eportfolio/ePortfolio_boom.pdf
- Weatherly, C (1995). When is Assessment Really Assessment? Measuring the Value of Human Capital, *The Christian Conscience (Vol. 1, No. 9, 1995, pp. 28–32, 50)*, Retrieved August 20, 2010 from http://www.crossroad.to/articles2/04/assessing_human_capital.htm.