Portfolio as an Assessment Method in PBL

A. Stojcevski* and X. Du†
* Victoria University/Faculty of Health, Engineering & Science, Melbourne, Australia
† Aalborg University/Department of Development and planning, Aalborg, Denmark

Index Terms: Portfolio, Assessment, Problem and Project Based Learning, Case Study

Abstract

Problem and Project Based Learning (PBL) is generally regarded as an innovative method for engineering education. When compared to traditional lecture-based or teacher-centered engineering curriculum, the PBL model appears to inspire a higher degree of involvement in study activity. The definition of PBL is still somewhat open and designing a PBL curriculum is dependent on the objectives of a particular institution. What is even more undefined and under developed in a PBL curriculum is constructive alignment.

The principle of constructive alignment is that the curriculum is developed so that the learning activities and assessment tasks are aligned with the learning outcomes that are intended in the unit of study. Therefore, assessment tasks and assessment methods are a critical issue not just in a PBL curriculum but also in a teacher-centered environment.

This paper focuses on a portfolio as a method of assessment in PBL environment. The paper will illustrate two case studies. The first case study will outline Victoria University in Melbourne Australia experience to evaluate projects by the use of portfolio, whereas the second case study will describe the Aalborg University Denmark experience of course assignment to assess students' process competencies.

1.0 Introduction

Problem and Project Based Learning (PBL) as a pedagogical teaching and learning method has been actively applied for many years. One of the first applications of PBL is recorded in the study of medicine in the 1960s [1, 2]. Since then PBL has spread in other higher education disciplines such as engineering, mathematics, business, and architecture. Problem-Based Learning is generally regarded as an innovative method for engineering education [3]. The success of this method is very much dependent on the theoretical learning principles encompassed by the method. When compared to traditional lecture-based or teacher-centered engineering curriculum, the PBL model appears to inspire a higher degree of involvement in study activity [3]. The definition of PBL is still somewhat open and designing a PBL curriculum is dependent on the objectives of a particular institution.

The key hypothesis of problem-based learning is that learning begins by dealing with problems which occur in the professional environment [4]. Traditionally, education within the School of Electrical Engineering at Victoria University (VU-SEE) has been structured according to the paradigm of separate courses. However, because professional training and individual learning practices do not support such dissection, this has led to an amplified gap between professional engineering training and education [5, 6]. The conversion of the Electrical Engineering program to the Problem and Project Based Learning (PBL) paradigm fundamentally enhances the relationship between the program and current University practices by incorporating cross-departmental and cross-faculty co-operation within the fabric of the program design, as well as the program delivery. This transforms the nature of the involvement of non-Electrical Engineering staff from one of "service provider" to one of "team member" or "co-owner" of the programs. Before outlining the details of the PBL approach in the School of Electrical Engineering at Victoria University, it is critical to identify the interpretation of "problem" based learning. The method which we have currently taken within the school in terms of the PBL "problems" has been a structured and focused approach, where the actual problems have been defined and structured by the teachers. One of the reasons for this approach is because of the time limitation which we had to develop the PBL curriculum. One of the aspects which we are currently trying to focus on within our PBL development team is to 'open-up' the problems from a narrow, defined problem, to a more broad scope. We believe this will make the curriculum even more student-centered in approach.

This paper looks into the assessment methods in a Problem Based Learning curriculum through two case studies. The first case study at Victoria University looks into a course undertaken by year 1 students in

[1] E-mail: Alex.Stojcevski@vu.edu.au

electrical engineering. The observation and data collection is performed by qualitative and quantitative research where participants are asked to rank the effectiveness of a portfolio as an assessment tool in the PBL course. What is interesting and very important here is the fact that the ranking is performed against each learning outcome of the course for maximum constructive alignment.

The second case study will describe the Aalborg University Denmark experience of course assignment to assess students' process competencies.

2.0 Assessing Learning

2.1 Assessing Group Projects

Assessment is one of the issues but this contains subsets of issues that affect the assessment as a whole. Issues such as managing group projects and dealing with group conflict can lead to a tedious assessment task. To reduce assessment time, every student in the group obtains the same mark although it has been found that it does not acknowledge individual contribution. To keep assessment time to a minimum, it might not be suitable to individually assess students. Nonetheless, research has found that using group work has its advantages and is summarised below [7]:

> *"The main advantage in using group work seems to be that students learn more and retain it longer when involved in "active learning". The student outcomes could be; students become better at being active and tolerant listeners; students help each other master content; and students give and receive constructive criticism and manage disagreement."*

These skills are beneficial to every individual. They can help students in their dealings with people at work. These skills relate closely to Graduate Attributes (GAs) of universities such as generic communication skills, working autonomously and collaboratively, working effectively in various social and cultural diversity situations. These GAs aim to help students be more employable and encourage life-long learning.

2.1.1 Why use group projects, what learning outcomes are they suitable for and why use group assessment?

Group projects are beneficial for students as they address a number of GAs of the University. The advantages found in the literature state that group work generates a large number of alternative points of view or solutions and it gives students the chance to work on a very large problem that is too complex for one individual to tackle. In addition, it allows students to work with others from differing backgrounds and allows students from all backgrounds to use their unique skills, knowledge and experience. Group work also gives students a chance to teach one another it provides an opportunity to practice skills applicable to professional situations. The indirect benefits of group work are: it provides an environment for students to speak confidently in class as they are in smaller groups, in which it avoids student anonymity. It also promotes greater students participation in class.

The learning outcomes associated with group work are as follows:

- Oral and written communication skills– students are required to participate in group discussions and usually to produce a written document.
- Information Literacy – all students are given a task to complete, which will often require them to research and report back to the team their findings and analysis.
- Teamwork skills – students have an opportunity in group work to refine their skills in cooperative working environment. This may include skills in negotiation, organisation and leadership.
- Working independently - each student is usually allocated a task, which they independently work on.
- Appreciation of difference – often it is the case that students are in teams comprised of students from diverse backgrounds.

The findings in the literature shows that group work makes students begin to know what they know and what they need to find out. Group work forms the basis for peer evaluation and assessment in skills such as organisation, negotiation, delegation, team work, co-operation and leadership.

Group work cannot be assessed using traditional methods such as exams. Therefore, other forms of assessment are used such as the use of presentation to assess individual contribution, the project work itself as a product and process, as well as reports. By using group assessment, it will reduce assessment time but poses a challenge of acknowledging individual contribution as well as singling out individuals who did not contribute.

[1] E-mail: Alex.Stojcevski@vu.edu.au

2.1.2 How can group projects be managed?

Before this learning issue is discussed, it must be noted that there is a difference between work groups and learning groups. Learning groups are more than just letting student work together; they are structured learning environments. Johnson, Johnson and Smith [8] reported that only under certain conditions can we expect cooperative efforts to be productive. Those conditions rely on a number of parameters; clearly perceived positive interdependence, considerable face to face interaction, clearly perceived individual accountability, personal responsibility to achieve the learning group's goals, frequency group processing of current functioning to improve the group's effectiveness, and, frequent use of relevant and small group skills. In work groups, the focus is on individual performance only and group members compete with each other and individual accomplishments are rewarded. Learning groups on the other hand focuses on group performance where group members believe that to succeed all group members must succeed. Thus, groups as well as individual accomplishments are rewarded. To reach a successful outcome from either group categories, it is important to effectively manage the group which includes preparing students for group work.

Initially, it must be established with the students the purpose of group work, what is expected from the group, and what is to be achieved from this process. Thus, preparing students for group work must in some way be accomplished. Another consideration is how much time students should allocate to this project. This in turn will reflect on the amount of effort the teacher is expecting. In addition, time must be organised for group meetings to reduce poor group communication.

Important factors that contribute to the successful outcome of group projects are the student allocation procedure to a group as well as the allocation of a project topic to a group. Veljanovski, Stojcevski et al have devised a project management procedure to address the above with respect to industry based group projects [9]. The successful completion of projects is principally dependant on students' abilities/knowledge in a particular field of a discipline. Therefore a project selection procedure is applied before a student can commence a project and it applies to individuals before they are grouped to suitable projects.

- Project topic proposal - Each student is required to submit a resume which includes their post-graduate grades from their program to date as well as relevant work experience. The second document is their order of preference in regard to project topics available.
- Project topic allocation – Each project topic proposal is processed by a selection panel. The selection panel includes the project manager for the Project Unit of the program, affiliated academic staff and the relevant industry partner whose project topic was preferred. All parties arrive at a decision on the suitability of the student for that project topic (based on the order of preference given). Students are then notified of the outcome.
- Supervisor allocation – The selection panel decides upon appropriate supervision for students. This may include academic supervision or both academic and industry supervision (dependant on project topic). Students are required to meet their respective supervisor(s) on a weekly basis. Supervision includes advice and monitoring the project solution alternatives; monitoring progress; advising about reporting and assessment.
- Legal procedures – Students working on industry projects are bound by a three way non-disclosure agreement (NDA) between the university, industry and themselves. Students cannot commence a project if the NDA is not signed. An Intellectual Property (IP) agreement between the university and the respective industry is also negotiated.

The project selection procedure is in general complete before the semester commences as students provide their project topic preferences in advance before the start of semester. On project commencement, each student is required to submit a project proposal to their respective supervisor(s) which includes details such as project / module breakdown, tasks, timelines and milestones. Supervisors act upon the project proposals and set out assessment schedules for demonstrations of the various tasks and modules which also include oral presentations.

An important role of managing group projects is to sustain them through the allocated time and avoid group conflict. Chang has shown that using group evaluation forms has been successful to monitor individual contribution to group work [10]. Students who complete such forms must evaluate their own contribution to the group and also the contributions of other group members. It was found that such evaluations have worked effectively as it can help identify problems in the early stages of group work. For many groups, this early identification has typically resulted in the rejection and subsequent removal of the underperforming member by the group. Many groups have found that peer evaluation is an effective mechanism to get the group to work together as a team and to make teams work. Many students have indicated that they were committed to their group work simply because they were assessed by their fellow students.

It is clear that managing group projects is tedious for the teaching team involved with respect to student

[1] E-mail: Alex.Stojcevski@vu.edu.au

allocation to groups, project allocation as well as conflict resolution. Therefore it is; essential to be purposeful to increase students learning and productive use of time; prepare students for success; and be flexible as well as vigilant.

2.1.3 How can group projects be assessed?

There has been significant research carried out in terms of group work and the implication of assessing it. Literature suggests that student group assessment is usually divided into a number of categories which could include individual contribution to learning group, presentations and report submissions. This might also depend on the academic level of the students. Veljanovski, Stojcevski et al have looked at the assessment implications in the final semester of an engineering Master program, where a group major project is the full load [11]. They argue that students recruited into the major project are graduates and are assumed to have a certain level of maturity; therefore, there are no specific formal diagnostic processes for early detection of students at risk. In addition to this, project supervisors are vigilant during their project sessions for students who are struggling and who are then provided with additional support.

Assessment tasks are both summative and formative and where possible are staged so as to provide rapid feedback for students and staff. The performance of each student is assessed based on project progress, project demonstration, project dissertation, and final presentation. The project dissertations of approximately 15,000 words are examined by two examiners selected by the examining panel. Each student demonstrates the operation of the project to the panel of at least two members. Project material is kept centrally and this is made available to other members of the consortia, unless intellectual property (IP) issues are involved. Assessment in the subject is also reviewed at the time of the examiners' meetings to ensure that that there is parity in student performance.

Peer assessment has in recent years has also been heavily exploited in group assessment. Conway et al describes the introduction of peer assessment into group assignments [12]. In response to students' complaints about the fairness of the group assessment, they developed a method of rewarding individual effort in projects based on a modification of the Goldfinch & Raeside procedure [13]. Goldfinch and Raeside were the first to report their method using peer assessment of group projects. Goldfinch described refinements to an earlier peer assessment scheme for awarding marks to individuals after a group project [14]. The original method was a two part scheme in which students firstly identify which group member performed which tasks and then the students assigned a mark for the group work skill. Goldfinch later stated that only students' assignment of marks needs to be calculated for a reliable score of student contribution. Conway et al also argue that students found awarding an individual weighting for their contribution simple and transparent.

2.2 Learning portfolio as a method of assessment in PBL

The learning portfolio is a rich, flexible document that engages students in continuous, thoughtful analysis of their learning [15]. It is often used as an assessment method, which requires a purposeful collection of student work that exhibits the student's efforts, progress, and achievements in one or more areas of the curriculum [16]. This collection should represent a collection of students' best work or best efforts, student-selected samples of work experiences related to outcomes being assessed, and documents according growth and development toward mastering identified outcomes [17].

In this new era of performance assessment related to the monitoring of students' mastery of a core curriculum, portfolios can enhance the assessment process by revealing a range of skills and understandings one students' parts; support instructional goals; reflect change and growth over a period of time; encourage student, teacher, and parent reflection; and provide for continuity in education from one year to the next [18]. Teaching staff can use them for a variety of specific purposes, including [18]:

- Encouraging self-directed learning.
- Enlarging the view of what is learned.
- Fostering learning about learning.
- Demonstrating progress toward identified outcomes.
- Creating an intersection for instruction and assessment.
- Providing a way for students to value themselves as learners.
- Offering opportunities for peer-supported growth.

Developed through a process of reflection, evidence, and collaboration, the portfolio may be paper, electronic, or another creative medium [19]. At its center, the power of writing and reflection are combined with purposeful, selective collection and assessment of learning endeavors and outcomes in order to improve learning [20].

[1] E-mail: Alex.Stojcevski@vu.edu.au

In practice, learning portfolios have been well-applied into teaching activities in varied learning environment to support reflection, sound assessment, and collaboration. Portfolios have been implemented in a variety of ways, and the application can be at the level of courses, across discipline courses, projects and programs, etc. It is also a rather contextualized method and the use of it to a great level depends on the learning goals, expected learning outcome, motivation level of students, contents of the curriculum, and so on. There is a growth of interest of applying it as an assessment method to the PBL environment due to its strength in promoting reflection and improving process skills in the learning process.

The following of the paper will provide illustration of two cases concerning the use of learning portfolio as assessment methods in two contexts – as a project assessment method at Victoria University, Australia, and as a course assessment method at Aalborg University, Denmark.

3.0 Use of Portfolio as a Course Assessment Method at Victoria University

3.1. Current Structure & Practice

This section provides a detailed description of the PBL based course "PBL & Engineering Practice - VEB1001" in which this research is focus on, in terms of the objectives of the course, the content, and the method of delivery [21].

3.2 Course "VEB1001 - PBL & Engineering Practice" in Question

Due to the fact that this research is mainly focused on obtaining data from students to see the effect of a portfolio as an assessment tool, it is critical to describe the course in which a portfolio is used. This course is "VEB1001 – PBL & Engineering Practice", and is 50% of the load in each semester of first year.

3.2.1 Course Objectives

This course is designed to create the opportunity for students to integrate generic skills with the technical engineering skills studied in Enabling Sciences 1A (VEF1001) and Electrical Fundamentals 1A (VEF 1003), which are supporting or scaffolding courses to VEB1001. The PBL approach to this course requires students to form a holistic consideration of problems, which are not only technical in nature but also exercise the students' generic skills. Students are required to demonstrate critical thinking, problem solving skills, systems thinking and professional engineering practice.

3.2.2 Content

This is a practical, PBL mode course in which students work in teams to solve a number of problems specifically designed to integrate with the learning and content from Enabling Sciences 1A (VEF1001) and Electrical Fundamentals 1A (VEF1003). There are three project identified specifically for this course each semester.

The first project requires the students to construct and test a circuit kit which is purchased by the teaching team. This project acts as a team building exercise and is not examined. The second project requires students to design and test an analog circuit. Some of the things which the students will need to report back on are on the use of the electronic equipment used to test the constructed design, and on some of the measurement taking techniques learned and discovered. As part of the reporting back to the supervisors, all students are asked to submit a written team report, an individual reflective report, which should cover what as an individual engineer have learned from this project, and a group oral presentation to summarise the findings and knowledge which students have gained from the project. The students are also required to participate in the workshops on Occupational Health and Safety, component handling and soldering, and information literacy. The third problem requires students to design and test a digital circuit. The material which they will cover in the supporting course VEF1003 (Digital and Programming parts) is aligned and closely related to this project.

Teams of students have an Electrical Engineering staff member as a 'supervisor' whilst working on these problems. Furthermore, the teams will also be assisted by a Language and Communications staff member, who is a 'co-supervisor'. Staff members from the Faculty of Business and Law, the Teaching & Learning Centre and the School of Architectural, Civil & Mechanical Engineering are also available to provide workshops to assist students with the development of generic skills and interdisciplinary learning.

3.2.3 Methods of Teaching

As mentioned earlier, this is a practical, PBL based course in which students work in teams to solve a number of projects [22 – 26]. There are also regular workshops to assist students with the development of

[1] E-mail: Alex.Stojcevski@vu.edu.au

generic skills. This course is delivered in PBL mode and involves intensive small group and team work under the supervision of an Electrical Engineering supervisor and is reinforced by the use of on-line software tools, collaborative learning, workshops, and seminars. The course is based on 15 learning outcomes with the aim that each student should obtain on the completion of the course. The 15 course learning outcomes (LO) for this unit are listed below:

LO1. Demonstrate the successful completion of a project(s) in a specified time period.
LO2. Demonstrate professional engineering skills.
LO3. Use a computer to perform word processing as a communication tool.
LO4. Use a computer to create spreadsheets and graphical outputs for reports.
LO5. Demonstrate an awareness of general electrical safety standards.
LO6. Demonstrate an understanding of the social and technical roles of a professional engineer.
LO7. Demonstrate an awareness of the uncertain nature of some engineering designs.
LO8. Communicate to professionals and non-professionals the "language of engineering".
LO9. Locate, evaluate, manage and utilise critically information for a range of purposes.
LO10. Utilise basic electronic devices and incorporate them into a working design.
LO11. Operate a range of standard electrical engineering laboratory equipment.
LO12. Demonstrate an ability to write software programs.
LO13. Demonstrate an ability to work as part of a team.
LO14. Demonstrate abilities in time management.
LO15. Demonstrate an ability to undertake lifelong learning and the capacity to do so.

The learning outcomes were all carefully designed by a team of academic staff members during the development phase of the curriculum. In addition, due to the fact that all engineering degrees in Australia are accredited by Engineers Australia (EA), during the development phase of these learning outcomes, they were all mapped to the EA graduate attributes or graduate competencies.

3.3 Analysis & Results

3.3.1 Questionnaire Design

Taking the elements for high-quality research into consideration, such as defining the problem, reviewing the literature, starting the hypothesis, developing and implementing the design, and collecting and analysing the data, along with the understanding of quantitative and qualitative research and its data analysis, a questionnaire was designed to assist with improving the constructive alignment within the electrical engineering program at year 1 level. The aims of the questionnaire were to obtain the following:

1. To obtain quantitative data on the use of portfolio as an assessment method in VEB1001 (course delivered through PBL) in order to achieve the 15 learning outcomes in the course listed in section 2.1.3 of this paper. Students were asked to scale their answers for each learning outcomes according to a ranking system which consisted the following:
    - Very Poor alignment = 1
    - Poor alignment = 2
    - Satisfactory alignment = 3
    - Very Good alignment = 4
    - Excellent alignment = 5
2. To obtain quantitative data on the benefits and difficulties on the use of portfolio as an assessment method in VEB1001.

3.3.2 Data Collection

The data collection was performed on two levels. The first level was the observation of the portfolios. Seventy five portfolios were observed for evidence used to justify the 15 learning outcomes part of the VEB1001 course. Each piece of evidence was reordered in a table to make the analysis easier.

The second level was the data collected through the questionnaire. Out of fifty participants who were asked take part, 38 responded to the questionnaire. This data collection was performed through two phases. The first phase of this data collection was performed during class time, and the other through an online email system.

The data from the quantitative question was all recorded in a table according to the scale used and then counted. Tools such as Microsoft Excel were used to table the data and obtain the appropriate graphical representations for all data collected.

[1] E-mail: Alex.Stojcevski@vu.edu.au

3.3.3 Portfolio Analysis

Overall, students performed well in most of the learning outcomes. Two evident shortfalls arise from the portfolio observations and analysis. One is the learning outcomes which are based on understanding PBL and its concept (LO6 and LO13), and the other is the learning outcomes which are based on time management and project management (LO1 and LO14). Fig 1 provides a view of the learning outcomes with an indication of the level of alignment in accordance to the evidence used by students to justify that particular learning outcome.

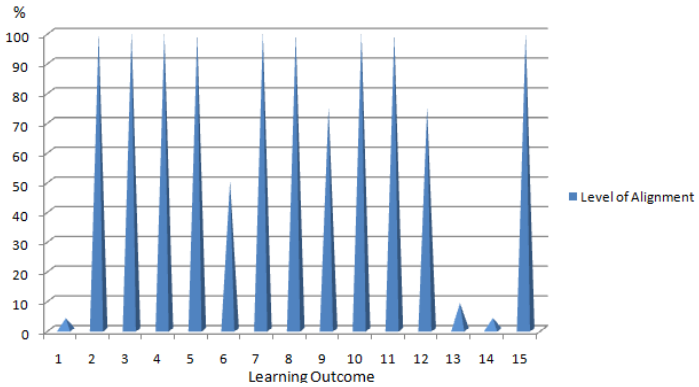

Fig 1. Level of Alignment from Portfolios

It is also clear from fig 1 that there is poor alignment in the two area mentioned earlier, one being project management, as per learning outcome 1 and 14, and the other students' basic understanding of problem based learning as a concept in teaching and learning, as per learning outcome 6 and 13. As it can be noticed in figure 4 the level of alignment for learning outcome 6 is at about 50%. The reason why this has reached 50% is because when students were asked to demonstrate an understanding of the social and technical roles of a professional engineer; majority of the students demonstrated with evidence the technical roles of a professional engineer; however the evidence for the social aspect was very poor. It could be observed here is that, if this learning outcome did not have a technical aspect to be justified, then the level of alignment would have been at about 4 – 7 %. For this reason the concern for this learning outcome is combined along with learning outcome 13.

Prior to making some recommendations, it is also important to analyze and comment on the quantitative and qualitative data, and the alignment to the portfolios analysis.

3.3.4 Quantitative & Qualitative Analysis

When the qualitative data in relation to the portfolio being used as an assessment method was analyzed, and this data was mapped to the quantitative responses in relation to the scaling of the learning outcomes, there are once again two areas of concern which arise. Below is a list of the difficulties or challenges which came out from the responses.

Difficulties

1. Lack of Project Management (P. M.) skills
2. Time Limitation
3. Team skills
4. Lack of understanding of PBL

From the list of difficulties above, it can be clearly seen that difficulty 1 is directly linked to the negative response given by students in relation to learning outcome 1 (Demonstrate the successful completion of a project in a specified time period) and learning outcome 14 (Demonstrate abilities in time management). Over 50% of responses indicated that there is poor alignment with what has been taught in the course and the assessment of this learning outcome. This is also in line to the amount and quality pieces that students used as evidence to justify this learning outcome, as was obtain by analyzing the 75 portfolios.

The other major concern was the level of understanding of what PBL is and how it should work, and team work. Referring to difficulty 3 and 4 in the list above, it can clearly be seen that this area of concern was also very noticeable in the quantitative data obtained when referring to learning outcome 6 (Demonstrate an understanding of the social and technical roles of a professional engineer) and learning outcome 13 (Demonstrate an ability to work as part of a team). This is also very much evident and in line with the quantitative data analysis and with the pieces of evidence which students used in the 75 portfolios which were analyzed.

[1] E-mail: Alex.Stojcevski@vu.edu.au

All other qualitative responses were very positive and well aligned with the quantitative data obtained and with the pieces of evidence which were used in the portfolios.

Fig 2 provides a view of the learning outcomes with an indication of the level of alignment in accordance to the quantitative data obtained. Due to the data being quantitative, it is important to show the level of "alignment" and the level of "non-alignment" for each learning outcomes' response.

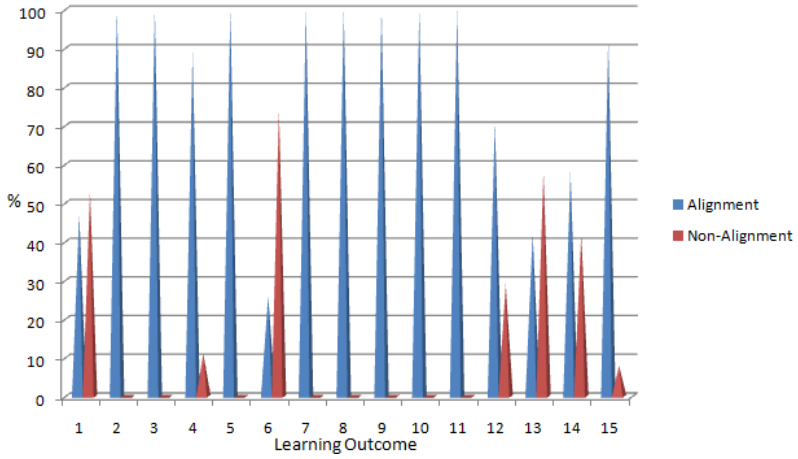

Fig 2. 'Alignment' & 'Non-Alignment' levels from Quantitative data

It is clear from fig 2 the four learning outcomes which suffer from poor alignment. They are learning outcomes 1, 6, 13, and 14. In terms of actions and recommendations for improvement related to these learning outcomes, as mentioned earlier in this paper, the four learning outcomes could be grouped into two 'concern' areas. As learning outcome 1 and 14 are focused on achieving projects in set time periods, this 'concern' area is referred to as "Project Management", and as learning outcome 6 and 13 are focused on achieving the social and team skills of a professional engineer, this concern area is referred to as "Engineering Practice - PBL Skills (EP-PBLS)".

4.0 Use of learning portfolio as a course assessment method at Aalborg University, Denmark

4.1 Process competencies as one the main learning goals in the PBL setting

Aalborg University has more than 30 years of experiences in teaching and learning in a PBL setting. In order to facilitate development of the required process competencies, a course named Collaboration, Learning and Project management (CLP) has been provided to the first year Danish students for more than 10 years. The CLP course includes theories and methods within the areas of co-operation, learning and project management. This course has functioned as a constructive tool for the first year students to learn how to learn and to develop process competencies in a PBL setting [3]. However, this course is only provided in the Danish language. Since 2002, the Project Organized Learning course (POL), which is an English version of the CLP course, has been provided to international master degree students at Department of Electronic Systems during their first academic semester (normally from the beginning of September to the end of January). The objective of the course is to provide an introduction to PBL concepts and to provide students with tools for learning and developing process competencies in the PBL environment at AAU.

The philosophical background of the POL as well as of the CLP course is rooted in constructivist learning theories such as, experience based learning and reflective learning and PBL learning principles as summarized by Graff and Kolmos [3].

The POL course has been under modification each year based on the variety of students' backgrounds. Since 2004, 7 modules are provided, scheduled and taught hand-in-hand with the first semester project work in order to facilitate the project progression and the application of theory to practice in the project work. Course contents include introduction to PBL, knowledge about and tools for developing process competencies in areas, such as, project planning and management, group dynamics, professional communication, and activities to develop learning strategies. Teaching methods in the POL course include diverse activities such as games, group discussions, exercises, role plays, students' presentations and so on. Lectures, which take up approximately 40% of the course time, are integrated into these activities in order to facilitate practice and reflection. In this way, students are encouraged to be active, communicative, collaborative and reflective.

[1] E-mail: Alex.Stojcevski@vu.edu.au

4.2 Using learning portfolio as aligned assessment method

The process competencies which students are expected to learn in the POL course, are assessed indirectly through the oral assessment of the written project report and process analysis. Therefore, it is not possible to document via numerical grades whether the students have achieved the process competencies aimed for with the course.

In order to enhance the higher level of students' reflection, learning portfolio was employed as an assessment method for this course since 2007. The objective is also to maximize the effect of this course so that students can make best use of the process competencies and apply them to their project work.

The assignment of learning portfolio requires students to individually write an essay of approximate 5-10 pages, which include 1) written narratives - experiences (what are they) + Reflections (meanings of the experiences); 2) appendix of materials – anything had special meanings or that can prove your learning.

In order to facilitate these engineering students with reflection, since the majority of them are not used to do writing assignment in the past school experiences, the following guidelines were provided:

- What were my goals/expectations for the course?
- How did they change during the semester?
- What did I gain from the course?
  - What did I learn about myself as a problem-solver?
  - What did I learn about project management?
  - What did I learn about professional communication?
  - What did I learn about myself as from working in a team?
  - What did I learn from the intercultural environment?
  - What was missing?
  - What was redundant?
- What new interests or values have I acquired so far?
- What learning activities were most/least valuable for me?
- What and how can I use these for life and future work?

In order to facilitate several loops of reflections, students were required to submit a first draft of their learning portfolio and afterwards make modification based on the comments of the lecturer (who is the second author of this paper). Final version was expected to finish two weeks before they finish their project work so that there is room to improve their collective report.

A qualitative research was conducted to investigate the effect of using portfolio as assessment on students learning. Qualitative interviews were conducted in the form of focus group after the submission of their learning portfolio.

Preliminary analysis of the interview results show that in general writing portfolio was a challenging task for engineering students due to their lack of experience in the writing and subjective way of reflection. However, results also show that there is a good potential to use it a motivating way of reflection when proper facilitation is provided, for example:

- precise instruction on how to write,
- the sample of the lecture's own portfolio through teaching the course,
- comments from the first draft and possibility of modification before the final version is made.

With the positive effect of writing learning portfolio, most students reflected that they efficiently managed to understand the philosophy of the PBL environment and develop new learning strategies to manage group based project work.

5.0 Conclusion

In this paper we have addressed the use of a learning portfolio as an assessment method in a PBL environment in engineering education, with the presentation of two different ways of using this method in two different contexts. In general, this method seems to a beneficial and promising approach to help students with deep reflection so as to develop process competencies in a PBL setting. There is, however, a need to reflect on how to apply this method properly in order to maximize its effect. An agreement can be reached by reflecting on the two case studies concerning important principles:

- The philosophy of constructive alignment in choosing assessment methods.
- An agreement of between teaching staff and students on the learning outcome and why using portfolio as

[1] E-mail: Alex.Stojcevski@vu.edu.au

an assessment method.

- Sufficient and proper facilitation by the teaching staff in students' learning process by a combination of support and challenge, help the learner to identify his/her own learning needs, encourages the learner to develop their own learning strategies and to discover their own solutions to problems, helps the learner reflect critically on the experience and explore different perspectives.
- Facilitating students of further reflection after finishing their portfolio.
- Continual reflection by the teaching staff on how to improve the use of the methods.

With the limited space, this paper provides only a limited part of the complex issues in assessment a PBL setting. In order to develop more application of learning portfolios as well as more appropriate assessment methods in PBL environment, better strategies are needed and more research work will be of good contribution. Therefore, the work with developing using learning portfolio as an assessment method as well as how to study the effect through educational research will be continued further.

REFERENCES

[1] H. Barrows, "How to Design a Problem-Based Curriculum for the Preclinical Years," *Springer, New York*, 1985.

[2] H. Barrows, "Problem-Based Learning in Medicine and Beyond: A Brief Overview," *L. Wilkerson & W. H. Gijselaers (eds.), New Directions for Teaching and Learning, Jossey-Bass, San Francisco*, pp. 3-11, 1996.

[3] E. D. Graaff and A. Kolmos, "Characteristics of Problem-Based Learning," *International Journal of Engineering Education*, Vol. 19, No. 5, pp. 657-662, 2003.

[4] W. H. Gijselaers, "Connecting Problem-Based Practices with Educational Theory," L. Wilkerson and W. H. Gijselaers (eds.), *Bridging Problem-Based Learning to Higher Education: Theory and Practice*, Jossey-Bass, San Francisco, 1996.

[5] D, Boud, "Problem-Based Learning in Perspective," *D. Boud (ed.), Problem-Based Learning in Education for the Professions, HERDSA*, Sydney, pp. 13-19, 1985.

[6] D. Boud, G. Feletti, "The Challenge of Problem-Based Learning," *Kogan Page, London*, 1991.

[7] B. G. Davis, "Tools for Teaching," *Jossey-Bass, San Francisco*, 1993.

[8] J. Johnson, S. Johnson, "Active Learning: Cooperation in the College Classroom," *Interaction Book Company, Edina, MN*, ISBN 0-939603-14-4.

[9] R. Veljanovski, J. Singh, A, Stojcevski, "Innovative Approach to University – Industry Partnership in Project Management," *IADAT Journal of Advanced Technology*, 2005.

[10] V. Chang, "How can conflict within a group be managed?," *8th Annual Teaching Learning Forum*, The University of Western Australia, Perth, 1999.

[11] J. Singh, R. Veljanovski, A. Stojcevski, "Industry – University Based Curricula to Address Skill Needed in Microelectronics," *International Conference on Engineering Education and Research* "Progress through Partnership", VŠB-TUO, Ostrava, ISSN 1562-3580, 2004.

[12] R. Conway, D. Kember, et al "Peer Assessment of an Individuals Contribution to a Group Project," *Assessment and Evaluation in Higher Education*, vol. 18, no. 1, pp. 45-56, 1993.

[13] J. Goldfinch, R. Raeside, "Development of a Peer Assessment Technique for Obtaining Individual Marks on a Group Project," *Assessment and Evaluation in Higher Education*, vol. 15, no. 3, pp. 210-231, 1990.

[14] J. Goldfinch, "Further Developments in Peer assessment of Group Projects," *Assessment and Evaluation in Higher Education*, vol. 19, no. 1, pp. 29-35, 1994.

[15] J. Zubizarreta, "The Learning Portfolio: Reflective Practice for Improving Student Learning," *Jossey-Bass*, 2004.

[16] I. Nikolova, B. Collis, "Flexible learning and design of instruction," *British Journal of Educational Technology*, Vol. 29, No. 1 pp. 59-72, 1998.

[17] U. of Oklahoma, "Learning portfolios' create broader awareness of educational achievement," *Spot Light of Teaching*, Vol. 21, No. 1, *The University of Oklahoma*, 2001.

[18] F. L. Paulson, P. R. Paulson, C. A. Meyer, "What Makes a Portfolio a Portfolio?," *Educational Leadership*, pp. 60-63, 1991.

[19] P. Tynjälä, "Writing as a tool for constructive learning: Students' learning experiences during an experiment," *Higher Education*, Vol. 36, No. 2, 209-230, 1998.

[20] T. Dornan, C. Carroll, J. Parboosingh, "An electronic learning portfolio for reflective continuing professional development," *Medical Education* Vol. 36, No. 5, pp. 767–769, 2002.

[21] A. Stojcevski, R. Veljanovski, "Electrical Engineering & PBL: From a Teacher-Centered to a Student-Centered Curriculum," *iNEER Book, Innovations*, 2007.

[22] E. D. Graaff, A. Kolmos, "Characteristics of Problem-Based Learning," *International Journal of Engineering Education*, Vol. 19, No. 5, pp. 657-662, 2003.

[23] C. Tang, et al., "Developing a Context Based PBL Model," *R. Conway, L. Fisher, L. Sheridan-Burns & G. Ryan (eds.), Research and Development in Problem-Based Learning*, Vol. 4, Integrity, Innovation, Integration, Newcastle, Australian Problem Based Learning Network, 1997.

[24] R. C. Bogdan, S. K. Biklen, "Qualitative research in education: An introduction to theory and methods," *Boston: Allyn & Bacon*, 1998.

[25] J. R. Fraenkel, N. E. Wallen, "How to design and evaluate research in education," *(2nd ed.), New York: McGraw-Hill*, 1993.

[26] E. J. Mason, W. J. Bramble, "Research in education and the behavioural sciences," *Madison, WI: Brown and Benchmark*, 1997.

[1] E-mail: Alex.Stojcevski@vu.edu.au