

## **AC 2007-1416: ONLINE ROLE PLAYING IN A NEW PROBLEM BASED LEARNING CURRICULUM IN ELECTRICAL ENGINEERING**

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Ronny Veljanovski received his Bachelor of Science in 2000 from Victoria University, Melbourne Australia. After completing his Bachelors, Ronny completed his PhD in electrical engineering (also at Victoria University). His thesis involved the design and implementation of low power reconfigurable architectures for wireless communications. His research was financially sponsored from Ericsson in Sweden and supported through the Heterogeneous Signal Processing Group which is a collaboration of universities and industries in Europe. Ronny has also recently completed a Graduate Certificate in Tertiary Education from Victoria University and now is currently completing a Masters in Problem Based Learning in Engineering and Science at Aalborg University in Denmark. Currently Ronny is employed by Victoria University in the School of Electrical Engineering as a Senior Lecturer. His teaching ranges from post-graduate masters in microelectronics to undergraduate electrical engineering courses in the new Problem Based Learning teaching and learning style. Ronny's research interests are in enabling technologies, such as microelectronics, to provide solutions to e-health applications.

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Dr. Alex Stojcevski is a Senior Lecturer in the School of Electrical Engineering and a research associate of the Centre for Telecommunications & Microelectronics, Melbourne Australia. He holds a Ph.D. degree in Engineering, Masters by research degree in Engineering, a Bachelor degree in Electrical Engineering, a Masters degree in Education, and he is currently pursuing a Masters degree in Problem Based Learning (Engineering & Science) from Aalborg University, Denmark He has been teaching at Victoria University at undergraduate and postgraduate since 1999. His goals in teaching are not just to promote learning of the subject matter, but also to assist students to learn and think logically and learn problem-solving methods and techniques. Dr. Stojcevski is the chair of the Problem Based Learning (PBL) first year core development team in the School of Electrical Engineering. In addition, Dr. Stojcevski is a member of the PBL Steering Committee in the Faculty of Health, Engineering & Science and the course coordinator for PBL & Engineering Practice 1A and PBL & Engineering Practice 1B. In addition, Dr. Stojcevski is Faculty member of the Board of Studies in the Faculty of Health, Engineering and Science. On the research forefront, Dr. Stojcevski has published over fifty book chapter, journal and conference publications. He has been a technical committee member in a number of IEEE conferences and has reviewed a number of theses, journals and conference publications. In addition, Dr. Stojcevski has been a session chair of number if IEEE conferences and a member of conference organising committees.

# On-Line Role Playing In a New Problem Based Learning Curriculum in Electrical Engineering

## Abstract

Role playing has been used as a teaching tool across various disciplines for a very long time<sup>1-4</sup>. This paper presents on-line role playing simulations in support of the e-learning components of the problem based learning (PBL) programs in the School of Electrical Engineering, Victoria University (VU) that commenced in 2006. There are many challenges in PBL such as the design problems that will allow students to explore many facets of a problem and eventually learn what is needed to solve it. Another challenge is to try and make the problems constructively aligned with the desired learning outcomes of the unit of study. Nonetheless, students will be working in teams on different aspects of the problems. The issue we are faced with in regards to team work is trying to engage students in the problems and to make the problem exciting. As these problems will mimic industry problems, role playing has brought the problems to life. The results indicated a positive outcome.

## 1. PBL in Electrical Engineering at Victoria University

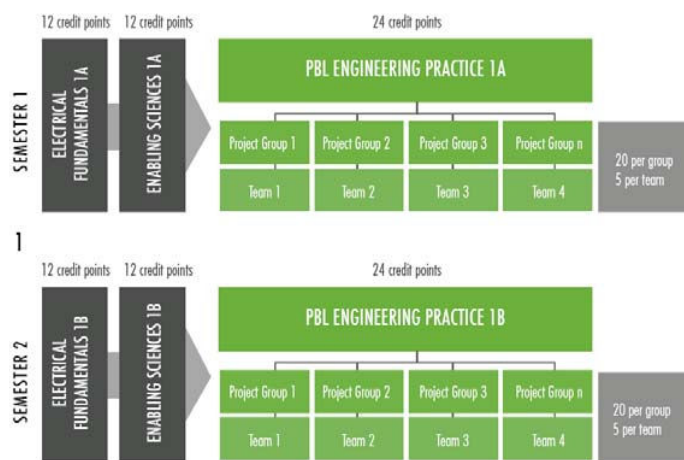


Figure 1: Electrical Engineering PBL year 1 program

VU has always liaised with its stakeholders whom consist of community, university staff and students and industry to determine the competencies a professional engineering graduate should possess. Recent feedback from VU's industry stakeholder expressed that 'soft/generic skills' were competencies that the university engineering graduates needed to develop further. Based in this feedback, senior management at VU reviewed many teaching and learning

styles that have strong emphasis on generic/soft skills. A final decision

by senior management concluded that PBL will be the teaching and learning style for all engineering programs in the University and initiated a top down approach to change all engineering curriculum. This top down push was similar to that of Aalborg University's chance process. The decision to change to PBL was made by Aalborg's senior management and the engineering college<sup>5</sup>. Reflecting on VU's change process, there were clear similarities with organisational literature on change based on Kotter's model<sup>6</sup> and the eight steps to transformation. In semester 1 of 2006, all electrical engineering undergraduate programs were launched with a PBL teaching and learning style. Prior to the launch, intensive curriculum design took place as well as infrastructure development. During the initial phases of the curriculum development, many PBL models were analysed and evaluated. The electrical engineering team

was provided with significant input from Aalborg University, Denmark and Central Queensland University, Australia. Their models and practices were evaluated and those that would be beneficial to VU and its cohort of students were adapted.

Aalborg University's Project Oriented Problem Based Learning<sup>7-9</sup> was determined by academic staff in electrical engineering to be the most suitable model for the electrical engineering programs. The structure of the first year, as illustrated in Figure 1, demonstrated many similarities between VU and Aalborg's models. 50 percent of the program in the first year is the PBL project work which is supported by two non-PBL courses. These two courses aim to teach students the core fundamental knowledge that is required to successfully problem solve and complete projects in the PBL unit of study. Electrical Fundamentals introduces students to a range of fundamental knowledge underpinning aspects of circuit theory, analogue electronics, and computer software and hardware. Enabling Sciences introduces students to physics and mathematics.

Students are self-formed in groups of 20 where they will be self-allocated to teams of 5-6 within that group. Each group has one respective supervisor (teacher) in Year 1. The same teams of students meet regularly throughout the semester in which they will work on a series of problems. Each team has one allocated "home room" in which they can work together and meet their supervisor on a weekly basis. In addition, students have access to laboratories to run experiments. Meetings with student teams and supervisors follow the PBL five main steps adapted from the PBL handbook<sup>10</sup>.

The 5 step cycle is illustrated in Figure 2. Each week, students meet with their respective supervisor for one hour in which an agenda is discussed. The agenda should contain topics that the students can obtain most guidance from their supervisor. In semester 1 and 2 of year 1, the problems were defined and selected by the teacher. This means that the teacher in the early transitional phase of the student's university education still had tight control over the direction of students learning. This was necessary with VU's cohort of students as it is diverse in many ways and based on past experience it is difficult to keep attrition rates low. This does not imply that the teacher reverted to traditional lecture based teaching methods; instead it implies that the teacher provided additional facilitation and had more input initially in the directions students took. By providing students with additional support in their early stages of their studies it is expected that eventually they will become accustomed to PBL and eventually become more independent learners where a pay off is expected in the latter years.

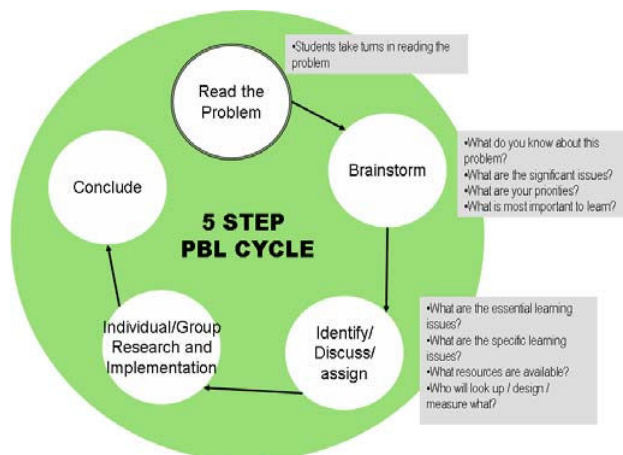


Figure 2: 5 Step PBL Cycle<sup>10</sup>

Another problem we have faced in the past is to keep students motivated as many students work extensive hours to financially support their studies, or have family commitments. This may pose a problem in PBL as it is team driven; therefore, students will have to become more motivated and engaged in their studies within a team environment. The challenge was to make the ‘problems’ not only mimic industry problems, but also put them in context and make them exciting in the hope that students will be engaged in them. It was decided that role playing the social, economical and political aspects of industry ‘problems’ will give the students a real grasp of the context<sup>11-14</sup>. Role playing has been used as a teaching tool across various disciplines for a very long time and the philosophy of role playing as a pedagogical tool relies on the fact that experience is the best teacher<sup>1-4</sup>.

## **2. Project Aims**

The general aim of the project was to engage students in learning with the use of an online role playing simulation platform to complement the PBL subjects in the School of Electrical Engineering. The greater aim was to help students achieve specific learning outcomes of the unit of study:

- Develop familiarity with the concept of renewable energy for sustainable development.
- Demonstrate an understanding of the advantages/disadvantages of greener technology based on scientific principles.
- Develop an understanding of the broader social issues of professional engineering.
- Understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development.

In semester 1 of 2006, this project was applied to PBL Problem entitled “Renewable Energy” in an effort to assist the students to meet a particular set of learning outcomes. In semester 2 of 2006, this project was applied to the PBL semester long project entitled “Traffic Automation”.

## **3. On-Line Role Playing Scenarios**

This project was powered by the Fablusi on-line role playing platform<sup>14</sup>. Fablusi simulations are aimed at modeling human interactions and relationships where users can author the platforms and customize the on-line interactive environments. It can be used to create dynamic scenarios or a series of interconnected cases for PBL, case based learning or dynamic goal based learning. The authoring environment is flexible, as it allows authors to design experiential learning interactive spaces in which characters (participants) act out their roles.

The online simulation scenarios in this project aim to help students achieve learning outcomes in regards to “sustainability” of engineering. These online simulations required interactive web based development in which the main features were discussion boards, electronic mail system, file managers and interaction spaces. The unique feature of all of these as compared to other systems such as WebCT is that the students play in character and cannot determine other’s real identities. The scenarios for semester 1 and 2 are as follows:

## Semester 1 2006 - Is Renewable Energy Worth It?

Figure 3 presents a screen shot of the on-line environment. The scenario was as follows:

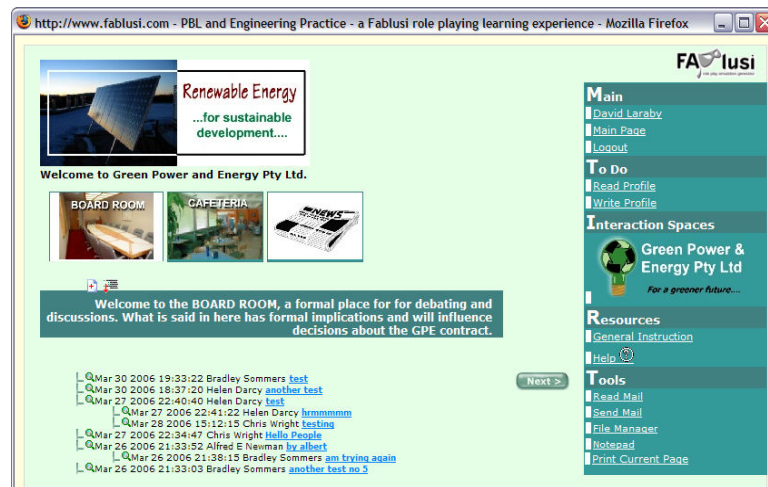


Figure 3: Semester 1 on-line role playing environment

*A new team of engineers has been recruited by Green Power and Energy Pty Ltd (GPE) and this team has its first project to investigate adding solar power systems to GPE's product line, although GPE has no experience in using solar arrays (based on photovoltaic cells). GPE is a member of the Australasian Alternative Energy Association (AAEA), an association of businesses in the renewable energy industry. Members of the*

*AAEA want to avoid duplication of research effort and more importantly, they want to make sure that underlying the use of alternative energy from GPE has sound scientific arguments rather than ideological arguments. The Australian Government has called on leaders from interested groups in the renewable energy industry to review and debate the issues and recommend alternatives in light of a possible major AAEA contract to GPE. GPE has invited participants to its premises to discuss the issues and try to influence the recommendations. For security reasons, GPE has taken a photo of all participants for the discussion.*

The characters and their positions in the matter for this role play were:

### Alfred E Newman, CEO of Green Power Pty Ltd

You are the CEO of Green Power Pty Ltd and you've been in that position for 2 years now. Your interests are mainly in increasing profits, although you are aware of the benefits of renewable energy. Your company really needs this contract and so you want to make sure that the recommendations from the group are positive. As the CEO of Green Power and Energy you have to welcome all participants to the board room. If you are not the first person to post a message, please explain why you are late to the board room.

### Bradley Sommers, Energy Consumer Association (end user)

You are the Chairperson of the Energy Users Association Group, an end user, of such green technology. Your viewpoint on such technology is mixed as the process to manufacture greener technology sometimes outweighs the benefits gained. Your members are mainly large companies - but there are many green groups that are also members so you have to balance your views between lower costs and your image as a Green energy supporter.

Chris Wright, Movement against Greener Technology

You are a representative from a coalition of individuals who are against Green Technology. The coalition is mostly companies that see green energy as a waste of time - where the costs are too high with no real benefits to the company. You have a group of scientists in your organisation who argue that the sorts of green technology being developed at present are simply inefficient and do not really affect environments in the way that green ideology suggests. In fact the long term effects are too minuscule to do any good.

David Laraby, Movement for Greener Technology

You are a representative from a coalition of people in favour of greener technology and are here both to fight your case against the representatives who are against greener technology as well to promote it further. You have close contacts in government circles that support you because you bring in votes and because you have the ear of the Minister for the Environment. You have been involved in many organised protests against companies that pollute the environment and, even though your personal views are not radical - you know that some of your members are willing to take radical action.

Ed Duyker, Representative from the AAEA

You are a representative from the Australian Alternative Energy Association. Your interests are to promote renewable energy and greener technology. However, you want to make sure that underlying the use of alternative energy are sound scientific arguments. You believe that any company that claims to be 'green' must have scientific evidence/reasons rather than just ideological arguments.

Helen Darcy, Representative from the World Nuclear Association

You are a representative from the World Nuclear Association. You believe that although "Renewables" like solar, wind and biomass can help, only nuclear power can offer clean, environmentally friendly energy on a massive scale. You are confident that in this debate at Green Power Pty Ltd, by focusing on facts rather than myths, you can demonstrate that nuclear energy can lead to sustainable global development.

To commence discussion and debate, participants select GREEN POWER & ENERGY from the Interaction Space (i-space) on the menu on the right (see Figure 3). This simulates entering the company premises and in this i-space, there are 3 areas to select from; BOARD ROOM, CAFETERIA and NEWS.

- BOARD ROOM: a formal place for debating and discussions. What is said in here has formal implications and will influence decisions about the GPE contract.
- CAFETERIA: can be used for informal discussions and general chit chat about issues of renewable energy. Things that are discussed and debated in here are not formal. Feel free to express any views in here that you may have hesitated to express in the BOARD ROOM.
- NEWS: Important news/announcements will appear in here. You can only read the news, not post it.

Each character is to post a minimum of 4 messages in the BOARD ROOM per week to contribute to the formal discussion. There is no limit on the CAFETERIA. The duration of the role play is 4 weeks inclusive, from Week 7 to Week 10 (inclusive) in Semesters 1 2006.

### ***Semester 2 2006 – Vehicular Alternative Energy – is petrol wearing thin?***

Figure 4 presents a screen shot of the on-line environment. The scenario was as follows:



Figure 4: Semester 2 on-line role playing environment

*The Australian Alternative Vehicular Energy Association (AAVEA) has called on leaders from interested groups in vehicular energy to review and debate the issue of how should we power motor vehicles in Australia and recommend alternatives to the Australian Government. The AAVEA has invited participants to its premises to discuss the issues and try to influence the recommendations.*

The characters and their positions in the matter for this role play were:

#### Amir, Representative from the Arab Petroleum Research Centre

You are a representative from the Arab Petroleum Research Centre. Your interests are to ensure that oil as a fuel source does not get eliminated from Australia's interests. However you want to make sure that underlying the use of oil/petrol are sound scientific arguments.

#### Luis, Chairman - Australian Alternative Vehicular Energy Association

You are the chairman of the Australian Alternative Vehicular Energy Association and you've been in that position for 4 years now. Your interests are to ensure Australian citizens have a sustainable, cost efficient fuel source for motor transport. Your association has been given the task to review the cases that will be presented by the other representatives in this discussion and to make recommendations in regards to which fuel source motor vehicles in Australia should use within the next 10 years.

#### Roberto, Alternate Vehicular Energy Consumer Association (end user)

You are a representative from the Alternate Vehicular Energy Consumer Association [end user]. Your viewpoint on such fuel sources for motor transport is mixed. Your members are mainly large oil companies - but there are many sustainable energy groups that are also members so you have to balance your views between lower costs and your image as a sustainable energy supporter.

#### Ronaldo, Movement Against Alternate Vehicular Energy

You are a representative from a coalition of individuals whom are against alternate energy for motor vehicles. You have a group of scientists in your organisation who argue that the sorts of alternative energy at present is simply inefficient and does not really effect environments in the way that alternative energy ideology suggests. In fact you believe that the long term effects are minuscule to do any good.

#### Sandra, Representative from the Hydrogen and Fuel Cells Corporation.

You are a representative from the Hydrogen and Fuel Cells Corporation. Hydrogen and fuel cells have the potential to solve several major challenges facing Australia today: dependence on petrol imports, poor air quality and greenhouse gas emissions. Your organisation is working with a number of partners to accelerate the development and successful market introduction of these technologies.

#### Zinedine, Movement for Alternate Vehicular Energy Sources

You are a representative from a coalition of people that favour alternative energy sources for motor transport and you are here to fight your case against the representatives whom are against you. You have close contacts in government circles that support you because you bring in votes and indeed have the ear of the environment minister. You have been involved in many organised protests against companies that pollute the environment and even though your personal views are not radical - you know that some of your members are willing to take radical action.

To commence discussion and debate, participants enter the i-space in which they can then select 2 areas: BOARD ROOM and CAFETERIA. Each character is to post a minimum of 4 messages in the BOARD ROOM per week to contribute to the formal discussion. There is no limit in the CAFETERIA. The duration of the role play is 4 weeks inclusive, starting in Week 9 in Semesters 2, 2006.

#### **4. Project Evaluation**

A potential advantage of role playing is it complemented the enjoyment of learning in the PBL subjects. The role of the teacher / facilitator in the PBL problems was critical for guidance of the learners as a provider of scaffolding. The added enjoyment of role playing, in a safe environment and controlled environment, has deepened the learning experience for students and thus yield improved learning outcomes. Both semesters' role play simulations were evaluated by a questionnaires as well as "Minute Paper" classroom assessment technique for open ended responses for particular aspects of the project. The questionnaire contained the following categories:

##### Survey 1: Student perception of a simulation as an instrument for learning

1. The simulation was instrumental in enabling me to carry out research on the Internet in order to develop debating viewpoints appropriate to my assigned role in PBL.
2. The simulation was instrumental in enabling me to look beyond the technical roles of engineering and understand the broader social implications.



3. The simulation was instrumental in enabling me to evaluate generic aspects of the alternative/greener technology
4. The simulation was instrumental in enabling me to understand the effects of different assumptions underlying the pros and cons of technology in the role play
5. The simulation activity was useful in allowing participation in the learning activity by the entire PBL team simultaneously and in our own time.
6. The simulation activity was useful in allowing an approach to the Unit of Study in its entirety rather than one bit of information at a time.

*Scale: 1 = strongly agree  $\leftrightarrow$  5 = strongly disagree*

Survey 2: Generic questions in regards to social, political and generic aspects of sustainability

1. Understanding the limitations of alternative/greener technology.
2. Understanding the roles played by professional bodies and organisations in regards to alternative/greener technology.
3. Understanding the positive and negative roles of professional bodies and organisations in regards to alternative/greener technology.
4. Understanding the interests pursued by professional bodies and organisations
5. understanding the strategies that are used by professional bodies and organisations in pursuing their goals
6. Identifying the problems and pressures faced by professional bodies and organisations in pursuing their strategies in regards to alternative/greener technology.
7. Gaining knowledge about the social implications of alternative/greener technology.
8. Gaining knowledge about alternative/greener technology.
9. Understanding the effects of the media on the perception of alternative/greener technology.
10. Understanding the concepts of sustainability

*Scale: 1 = Fablusi was very useful  $\leftrightarrow$  5 = Fablusi was useless*

The Minute Paper in both semesters asked the following questions:

- Would the use of an Internet based simulation such as this influence your decision to take a course? If so, why? If not, why?
- The mail system in the simulator is NOT a real e-mail system. Please state what you think are the advantage(s), if any, of using this system
- Did the role play simulations create a learning environment that engaged you in the PBL exercise and did you find it enjoyable?

### ***Semester 1 2006***

At the end of the role play simulation in semester 1, students were asked to fill in the questionnaire form. The evaluation took place in Week 10 of semester 1, 2006 during the last 15

minutes of the scheduled PBL meetings with supervisors. A total of 34 questionnaires were received although the number of students who participated in the simulation was 69. Therefore the results presented here must be taken with a “pinch of salt” as it does not represent the entire cohort of students in the unit of study but it does give a good indication as to how successful the project was.

The results (please see Table 1) indicate that although there was some mixed feeling in regards to how effective simulations are as a learning tool, the mean result was positive. In addition, the generic questions asked of the students in regards to the role playing platform were overall positive, although there were some negative comments in regards to the usability of the environment. Therefore, some improvements, in regards to the interfacing and usability were made for the role playing simulation in semester 2 of 2006.

### ***Semester 2 2006***

At the end of the role play simulation in semester 2, students were asked to fill in the questionnaire form. The evaluation took place in Week 13 of semester 2, 2006. Feedback from students indicated that they had a heavy workload and a specific time and day during Week 13 could not be finalised for everyone to meet to complete the evaluation. Therefore, the evaluation form was placed on WebCT for students to download, fill in and return it by the end of Friday in Week 13. A total of 16 questionnaires were received although the number of students who participated in the simulation was 48. Therefore the results presented here must be also taken with a “pinch of salt” as it does not represent the entire cohort of students in the unit of study but it does give a good indication as to how successful the project was.

The results (please see Table 1) indicate that in a whole for both surveys, the results were positive. The results indicate that the simulation was effective and it did help students acquire the knowledge required. In addition, the generic questions asked of the students in regards to the role playing platform were overall positive, although there were a couple negative scores. The Minute Paper results were also positive, in that the students enjoyed the experience and appreciated the unique features of the Fablusi role playing simulation environment. There was some concerns in regards to the time the simulation was started as some students expressed it would have been better to do this simulation towards the beginning of semester.

### ***Comparison of Semester 1 and Semester 2 Results***

The means for each of the questions for both surveys were compared side by side in order to obtain a clear view whether or not the simulation in semester 2 was improved as compared to semester 1. The results presented in Table 1 clearly indicate that there has been an improvement.

The smallest improvement was in regards to Q1 in Survey 2 where there was only a 9.3% improvement. This question asked students whether or not they understood the limitations of alternative/greener technology. In semester 1, the question referred to green technology such as solar cells, and in semester 2, it was alternative vehicular energy. The largest improvement was in regards to Q10 of Survey 2 where there was a 31.7% improvement. This question asked

whether or not the role playing simulation was useful in helping them understand the overall concepts of sustainability.

The overall improvement, by averaging the mean scores from both semesters yielded an improvement of 17.86% on average. This illustrates a successful outcome and indicates that the students, on average, acquired the necessary knowledge to meet some of the specific learning outcomes as outlined in the project aims.

Table 1: A Comparison of Semester 1 and Semester 2 Mean Scores

Questions	Semester 1 Means	Semester 2 Means	Difference in %
<b>Survey 1</b>			
Q1	2.97	2.44	-17.95
Q2	2.50	1.94	-22.50
Q3	2.76	2.13	-23.14
Q4	2.29	2.06	-10.10
Q5	3.03	2.56	-15.41
Q6	2.88	2.38	-17.60
<b>Survey 2</b>			
Q1	2.41	2.19	-9.30
Q2	2.74	2.13	-22.31
Q3	2.38	2.00	-16.05
Q4	2.71	2.25	-16.85
Q5	2.53	2.19	-13.52
Q6	2.71	2.00	-26.09
Q7	2.41	2.06	-14.48
Q8	2.35	1.94	-17.66
Q9	2.85	2.56	-10.18
Q10	2.47	1.69	-31.70
<b>Average Means</b>	2.63	2.16	-17.86
<b><i>NOTE: The lower the mean scores the better. 1 scoring the highest and 5 scoring the lowest.</i></b>			

## 5. Conclusion

Online role-play simulation platforms have provided flexible and customisable interactive environments that can simulate various aspects of social, political and / or organizational contexts in the engineering discipline. These aspects are an integral part of the problems in the electrical engineering units of study. By taking on and playing the persona of a role, learners were led to reflect on the material from the perspective of personal experience and identity. This deep reflection was enhanced by being able to act out possibilities in a safe and collaborative environment. In addition, learners were absorbed in situations and contexts that highlight the learning outcomes and objectives of the engineering units of study.

The project was carried out over two semesters in 2006 and was evaluated by student feedback questionnaires to determine whether the role playing platform had increased their engagement in the PBL problems, and whether the role playing platform assisted them to meet the desired learning outcomes of the unit of study. The results collected from the surveys indicated positive results and yielded a successful project outcome, although not all students enrolled completed the evaluation surveys. Measures will be taken in 2007 to increase student completion of the evaluation surveys by making it compulsory by means of evidence students have to include in their portfolios.

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