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# USING THE ENHANCED PROBLEM BASED LEARNING GRID TO GUIDE THE DOCUMENTATION OF THE WIN-WIN SPIRAL MODEL

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**Abstract**

*For this study, we used a subsection of the enhanced Problem-Based Learning Grid (ePBL Grid) as a framework for reflection during the adaptation of the Win-Win Spiral model for the development and documentation of software engineering projects at the London Metropolitan University. We claim that the ePBL Grid is a useful tool to guide the documentation required when adopting the Win-Win Spiral model. We also argue that students can benefit from using the ePBL Grid to aid the documentation of the Win-Win Spiral model when working in small teams online, on campus or off campus within higher education institutions.*

## Introduction

Educating Software Engineers is fundamentally based on problem solving through which students assimilate and apply knowledge and skills to problems of varying complexity, size and from diverse domains. The level of understanding of the underpinning theory and the acquired skills need to be ascertained through assessment. Traditional unseen examinations have long ceased to be recognised as the sole method of assessment. Problem-Based Learning (Boud & Filetti, 1996; Trop & Sage, 1998; Woods, 1999) and a range of associated instruments provide a vehicle for developing and enhancing different types of capabilities. In this paper we adopt the enhanced Problem-Based Learning Grid (Oriogun et al., 2002) and the guidelines for the Win-Win Spiral model (Boehm, 1996; MBASE Guidelines, 2003 Royce, 1995) to facilitate learning and knowledge acquisition, with specific reference to cognitive skills development within a software engineering environment. We present a case study from a postgraduate software engineering module at the London Metropolitan University in support of this study.

## Background Information

The case study used for this paper is based on a postgraduate MSc Computing module titled Software Engineering, which the first author teaches at the London Metropolitan University. This is one of the four advanced core modules taught in the second semester of the course. In the 2002-03 academic year 28 students completed the coursework aspect of the course. There were 3 groups consisting of 6 students each, and 2 groups consisting of 5 students each. Each group had a designated tutorial assistant. The coursework represents 50% of the module overall, and the remaining 50% is the examination. The subject of our case study is the coursework component. The group we have chosen for this study consists of 6 mature students, 3 males and 3 females.

## Theoretical Basis

The theoretical basis underpinning the Win-Win Spiral model and the enhanced Problem-Based Learning

Grid is explained in this section. The Win-Win spiral model extends the original Spiral model, Boehm (1988) by adding Theory-W activities to the front of each cycle. The theory argues that a project will only succeed if the critical stakeholders are all winners. Figure 1 below shows how the Win-Win spiral model adopts the Unified Process (Royce, 1995; Boehm, 1996; MBASE Guidelines, 2003) in the development of software artefacts.

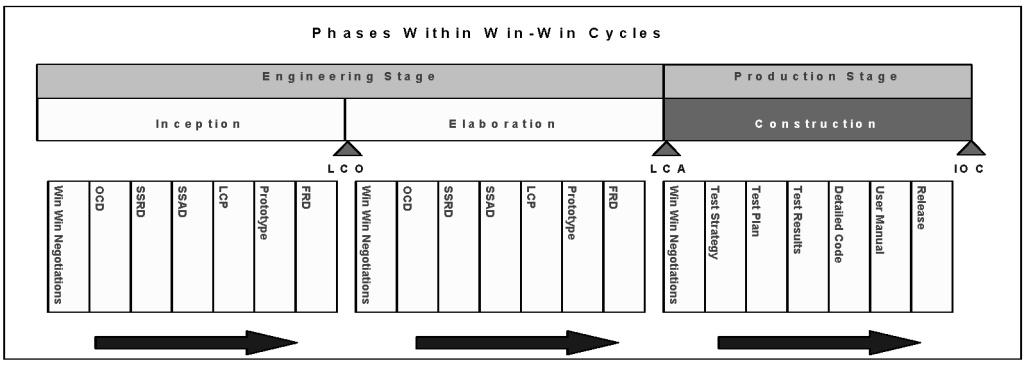



*Figure 1: Anchor points within the Win-Win Cycle (Boehm, et. al. 1997)*

The underpinning theoretical framework for the enhanced Problem-Based Learning Grid can be found in the model developed in Singapore as part of the national agenda for education. The "thinking programme" (Oon Seng, 2000), commonly known as the "Cognitive Modifiability Intervention (CMI)" was developed in order to enhance the ability for students to learn; to manage the learning process; for the development of students problem solving abilities and to afford students the ability to adapt to changing environment. The "Divergent-Creative Thinking Cluster" Oon Seng (2000;p.50) involved modules in developing creativity, referred to as "Problem Based Creative Learning". The model starts from "The Problem", then on to what is termed as the "Learning Adventure", followed by "Discovery Analysis and Solution Development" which leads on to "Solution, Reflection, Refinement Cycle". The "Problem Based Creative Learning" is broadly based on Problem Based Learning as recommended by (Bridges, 1992; Boud & Feletti, 1996; Trop & Sage, 1998). We have used the enhanced Problem-Based Learning Grid in this paper as a framework for reflection. Table 1 below shows the subsection of the ePBL Grid that we are reflecting upon in this paper. See Table 2 for the enhanced Problem-Based Learning Grid

| **Course Component** | **Multimedia Developer** | **Student** |
|---|---|---|
| Online Resources | • *Project-manage*<br>• *Design*<br>• *Test prototype* | • *Interactivity* |
| Tutorials / Seminars / Workshops | | • *Contribute*<br>• *Ask questions*<br>• *Engage in problem solving*<br>• *Report progress* |
| Computer Mediated Communication | • *Set up discussion groups* | • *Participate*<br>• *Engage*<br>• *Contribute* |
| Teamwork | | • *Research*<br>• *Present results*<br>• *Apply techniques*<br>• *Implement software*<br>• *Use tools*<br>• *Participate* |

*Table 1: The ePBL Grid in the context of our Case Study*

## Research Methods

Our research method is through the use of a case study. Foreman and Johnston (1999, 381-382) suggest that, "case studies can be based on real events in real organizations." Our research question is as follow:

*Is it possible to use the ePBL Grid as a reflective tool within the Win-Win framework?*

## The Enhanced Problem-Based Learning Grid (ePBL Grid)

The aim of the enhanced Problem-Based Learning Grid is to provide a structured representation of the kinds of activities undertaken by teaching and learning agents (Lecturer, Tutor, Multimedia Developer, Student - See Table 2) in order to facilitate the development of new courses that include problem-based learning as part of their pedagogical model.

| Course Component | Lecturer | Tutor | Multimedia Developer | Student |
|---|---|---|---|---|
| Lectures | • *Plan*<br>• *Schedule*<br>• *Liaise with tutors*<br>• *Deliver* | | | • *Attend*<br>• *Participate* |
| Online Resources | • *Liaise with developer*<br>• *Design input*<br>• *Provide content* | • *Facilitate*<br>• *Support* | • *Project-manage*<br>• *Design*<br>• *Give pedagogical advice*<br>• *Production of assets*<br>• *Test prototype* | • *Interactivity* |
| Tutorials / Seminars / Workshops | • *Plan*<br>• *Schedule*<br>• *Allocate* | • *Organise*<br>• *Facilitate*<br>• *Monitor progress*<br>• *Liaise with lecturer* | | • *Contribute*<br>• *Ask questions*<br>• *Engage in problem solving*<br>• *Report progress*<br>• *Criticize (Peer)* |
| Computer Mediated Communication | • *Moderate and contribute*<br>• *Set tasks* | • *Moderate and contribute*<br>• *Set tasks* | • *Set up discussion groups*<br>• *Set up chat rooms*<br>• *Set up video conference* | • *Participate*<br>• *Engage*<br>• *Contribute* |
| Research | • *Suggest*<br>• *Monitor*<br>• *Evaluate* | • *Suggest*<br>• *Help*<br>• *Focus* | | • *Plan activity*<br>• *Research*<br>• *Investigate*<br>• *Document* |
| Individual Assignment | • *Specify*<br>• *Monitor*<br>• *Evaluate* | • *Direct*<br>• *Monitor* | | • *Research*<br>• *Document*<br>• *Present*<br>• *Implement* |
| Teamwork | • *Specify task*<br>• *Allocate groups*<br>• *Liaise with tutors*<br>• *Evaluate results* | • *Monitor*<br>• *Assess Progress*<br>• *Provide Feedback* | | • *Research*<br>• *Present results*<br>• *Apply techniques*<br>• *Implement software*<br>• *Use tools*<br>• *Participate*<br>• *Deliver presentation*<br>• *Peer review* |
| Formative Feedback | • *Liaise with developer*<br>• *Provide content*<br>• *Provide feedback* | • *Liaise with developer*<br>• *Provide content*<br>• *Provide feedback* | • *Design /develop online materials*<br>• *Produce templates* | • *Self assessment*<br>• *Self diagnosis*<br>• *Peer assessment* |
| Summative Assessment | • *Plan*<br>• *Write*<br>• *Deliver* | • *Support revision* | • *Design /develop online materials*<br>• *Technical support on security issues* | • *Prepare*<br>• *Revise*<br>• *Attend*<br>• *Succeed* |

*Table 2: The enhanced Problem Based Learning Grid - ePBL Grid (Oriogun et al., 2002)*

## The Study

For our study, we used the Win-Win spiral model, which follows the Unified Process (Royce, 1995, p.127). The Win-Win framework adopts the Model-Based Software Architectures (Royce, 1995), which consists of four major milestones, namely, Life Cycle Objectives (LCO), Life Cycle Architecture (LCA), Initial Operational Capability (IOC), and Product Release Milestone (PRM). These milestones map directly onto the phases within the Unified Process and are achieved at the end of each phase - see Figure 1 above. This study focuses on the subsection of the ePBL Grid that we are reflecting upon as shown in Table 1 above.

We are concentrating on the first three milestones for this study. In the first part of the study, we will look at the Life Cycle Objectives (LCO). This section will cover the setting up of discussion groups, interactivity, including students contributions, participation, and their engagement by either asking questions within the group, answering questions, offering to deliver artefacts for the groups common goal, delivering relevant artefacts for the groups common goal or generally being active members of the group through the group's win-win negotiations; this will be followed by the LCA, and, finally, the IOC. For the IOC, we will present one of our 'Administrator' Use Case diagram and one of the Class diagrams (Stevens with Pooley, 2000, p.113) for the same Use Case diagram as agreed by the group after the win conditions of each stakeholder have been met during the group's win-win negotiations (see Appendix). A snapshot of our 'Administrator' interface will be presented as implemented by the group (see Figure 3).

### *Life Cycle Objective for the Bulletin Board System*

The LCO looks at the setting up of discussion groups by the students, the interactivity amongst the students, the online contributions made by each student, the level of engagement of each student and the overall participation of each student throughout the semester on the module. Table 3 below shows the aspect of the ePBL Grid being considered here:

| Course Component | Multimedia Developer | Student |
|---|---|---|
| Online Resources | | • *Interactivity* |
| Tutorials / Seminars / Workshops | | • *Contribute*<br>• *Engage in problem solving* |
| Computer Mediated Communication | • *Set up discussion groups* | • *Participate*<br>• *Engage*<br>• *Contribute* |
| Teamwork | | • *Participate* |

*Table 3: Using the ePBL Grid to Reflect on the LCO*

The group generated a number of documents in line with the Win-Win spiral model and Model-Based Software Architectures -see Figure 2. The group's Win-Win negotiations involved group members role-playing a number of key stakeholders including Clients, Developers, Administrators and Users of the Bulletin Board System (BBS) during the course of the semester. Each negotiation cycle involved discussion around all the sub-elements within the LCO. Conflicts were identified and if possible were resolved at this stage otherwise they were left for further negotiations in the LCA phase. The following table shows the second cycle of our negotiated win conditions with identified unresolved conflict involving all the stakeholders. Table 4 below shows how group members (stakeholders) participated, contributed, engaged in the discussion and generally interacted with the group during the development of the BBS.

| Condition | Priority | Conflict | | Result |
|---|---|---|---|---|
| | | With | Details | |
| Internet based application | High | None | - | Agreed |
| User friendly system (good navigation) | High | None | - | Agreed |
| Full access for uploading files and messages | High | 1. Operator<br>2. Client | 1. Difficult to maintain for operator<br>2. Abuse, misuse and Security problems may occur. | Conflict resolved: For security reasons it cannot be allowed. Unregistered User will therefore have read-only access to messages and files. |
| Full access for reading/downloading files and messages | High | Client | Client suggests access only to registered users | Conflict resolved: Unregistered User will be given read-only access to all messages and files. |
| Search Engine | Moderate | Developers | Lack of time. | Unresolved |
| Help Section | Moderate | - | - | Agreed |
| FAQ Section | Moderate | - | - | Agreed |
| Suggestion Box | Moderate | - | - | Agreed |

*Table 4: Conflict Identification and Resolution - Win-Win Negotiations Cycle 2*

### *Life Cycle Architecture for the Bulletin Board System*

The LCA looks at the project management and the design aspects of the ePBL Grid in particular, also each student's contribution and participation individually and collaboratively online as well as off line. This is where the research element of the ePBL Grid has a role to play, students had to apply a specific technique and use appropriate case tools for the delivery of various artefacts for the coursework. Table 5 below shows the aspect of the ePBL Grid being considered here:

| Course Component | Multimedia Developer | Student |
|---|---|---|
| Online Resources | • *Project-manage*<br>• *Design* | • *Interactivity* |
| Tutorials / Seminars / Workshops | | • *Contribute*<br>• *Ask questions*<br>• *Engage in problem solving* |
| Computer Mediated Communication | | • *Participate*<br>• *Engage*<br>• *Contribute* |
| Teamwork | | • *Research*<br>• *Apply techniques*<br>• *Use tools*<br>• *Participate* |

*Table 5: Using the ePBL Grid to Reflect on the LCA*

The Win-Win process is modelled using four main objectives (Boehm et al., 1998), Win Condition, Issue, Option and Agreement. The reconciliation phase attempts to resolve conflicts between win conditions. If a win condition is non-controversial (there is no conflict), it is covered by an agreement (Ag). Relationship between win conditions are established, leading to issues (I) being identified which raise the conflicts between win conditions and their associated risks and uncertainties. Options (Op) are considered which suggest strategies for resolving issues, which lead to agreements (Ag) that satisfy stakeholders win conditions and also define the systems objectives.

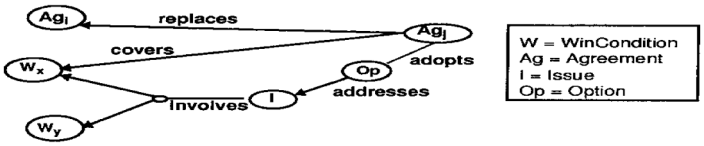



*Figure 2: Win-Win decision objects and relations between them (Boehm et al., 1998)*

Unresolved conflicts within the LCO were renegotiated during the LCA in order to reconcile Win-Win conditions for all the stakeholders of the BBS. The resulting agreed negotiated Win conditions are shown in Table 6 below. The difference between Table 3 and Table 4 is that it was felt by the stakeholders acting as Developers, that there was insufficient time to complete the implementation of the project, in particular the advanced features such as the search engine facility. During the cycle 3 negotiations of the LCA the group was granted an extra two weeks to complete the project. All parties were happy with implementation issues as documented in Table 6 below. Documents produced in the LCO stage were further refined in the LCA phase. The chosen architecture was further negotiated taking into consideration the analysis and design aspects of the BBS.

| Condition | Priority | Conflict | | Result |
|---|---|---|---|---|
| | | With | Details | |
| Internet based application | High | None | - | Agreed |
| User friendly system (good navigation) | High | None | - | Agreed |
| Read-Only access to files and messages | High | None | - | Agreed |
| Search Engine | Moderate | Developers | Lack of time. | Conflict resolved: Two weeks extension approved. |
| Help Section | Moderate | - | - | Agreed |
| FAQ Section | Moderate | - | - | Agreed |
| Suggestion Box | Moderate | - | - | Agreed |

*Table 6: Conflict Identification and Resolution - Win-Win Negotiations Cycle 3*

### *Initial Operational Capability for the Bulletin Board System*

The IOC looks at the implementation of the software for the coursework as a prototype, the software is tested and the results are presented together with a group report documenting all the stages within the Win-Win Spiral. Table 7 below shows the aspect of the ePBL Grid being considered here:

| Course Component | Multimedia Developer | Student |
|---|---|---|
| Online Resources | • *Test prototype* | |
| Tutorials / Seminars / Workshops | | • *Report progress* |
| Teamwork | | • *Implement software*<br>• *Present results* |

*Table 7: Using the ePBL Grid to Reflect on the IOC*

A number of documents were generated at the IOC phase in accordance with the Win-Win spiral model and Model-Based Software Architectures -see also Figure 1. The IOC is basically the implementation and the testing aspects of the Model-Based Software Architectures. For this paper, we will show a snapshot of the 'Administrator' interface and the test cases for the same interface of our BBS to be consistent with the previously illustrated Use Case and Class diagrams within the LCA. In Figure 3 below, 'Handle

Discussion' and 'Handle Files' buttons represent the 'Message Panel' and the 'Files Section' as depicted in The Appendix.

The website address for the main interface is http://simt.unl.ac.uk:9100/akk030/cctm/index.html. For the admin interface the user will require a valid username and password, which is *admin* and *cctmbbs* respectively, and can be accessed at http://simt.unl.ac.uk:9100/akk030/cctm/admin.html. During the IOC, the group conducted a total of 30 test cases for the BBS using the bottom-up software testing strategy approach (Pressman, 2000 p478) together with Black-Box testing technique (Pressman, 2000 p448). Table 8 below shows the 13 test cases performed specifically for the 'Administrator' interface.

| Test Case No | Test Details | Expected Output | Test Outcome |
|---|---|---|---|
| 1 | Administrator login. | Welcome message - verifies login | Successful. |
| 2 | Block User. | Confirmation of user blocked. | Successful. |
| 3 | User from Test 2 logs on. | Appropriate validation message displayed | Successful. |
| 4 | Unblock User. | Message confirms user unblocked. | Successful. |
| 5 | Log on as User from result of Test 4. | Welcome message, login successful. | Successful. |
| 6 | View user details. | Table of users displayed | Successful. |
| 7 | View suggestions. | Table of suggestions displayed. | Successful. |
| 8 | Delete messages. | Message status update | Successful. |
| 9 | Archive messages. | Message status update | Successful. |
| 10 | Retrieve archived messages | Message status update from Test Result 9 | Successful. |
| 11 | View messages from result of Test 10. | Message is back in normal folder. | Successful. |
| 12 | Attempt to return message from delete folder back to normal folder without clicking any checkboxes. | Validate message appears asking for a selection to be made. | Unsuccessful |
| 13 | Delete file. | Message update indicating new status of file. | Unsuccessful |

*Table 8: Test cases for the 'Administrator' interface*

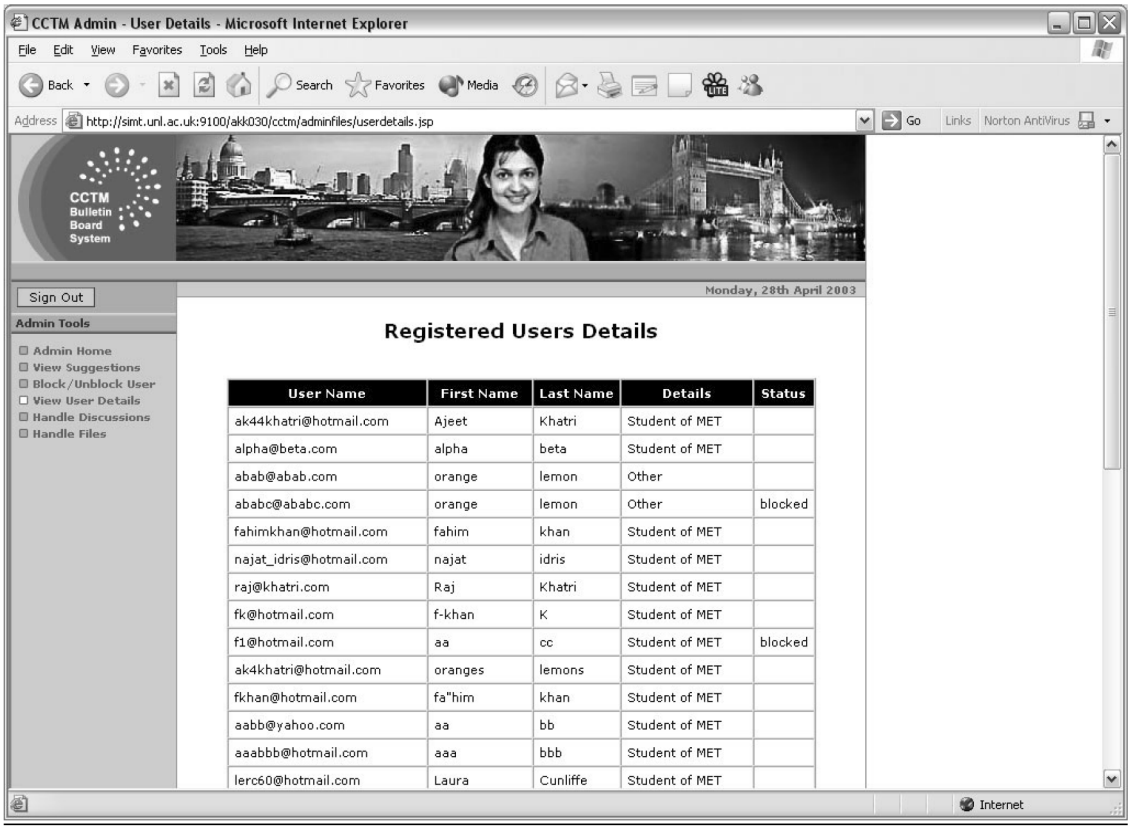



*Figure 3: Snapshot of the 'View User Details'*

## Discussion

In a previous study (Oriogun et al., 2002) the ePBL Grid was used as a framework for reflection for three multimedia case studies. The common issues raised as a result of applying the Grid include, the use of new technology, promotion of teamwork, and working with real-life problems. It was argued in the paper that the ePBL Grid can be used to promote self-directed learning, and that it provides a structure that facilitates the logical consideration of real-life problems. It can be an invaluable aid to course design, by providing guidelines for the kind of tasks that might be suitable for learners to undertake.

From previous research (Boehm et al., 1998), it was suggested that that the results from adopting Win-Win spiral would transition well into industry, however better document guidelines are needed. Researchers at the University of Southern California are currently updating the documentation required for the Win-Win Spiral model, their version is generally known as the Model-Based (System) Architecting and Software Engineering -MBASE Guidelines (2003). In this article we argue that students can benefit from using the ePBL Grid to aid the documentation of the Win-Win Spiral model when working in small teams online, on campus or off campus.

## Conclusions

We have addressed our original research question by showing that it possible to use the ePBL Grid as a reflective tool within the Win-Win framework as documented in this paper. The ePBL Grid also encourages discussion, criticism, reflection, research, peer assessment, and provides a forum that fosters interaction between students, groups of students, the use of news conferencing facilities and a forum that facilitates engagement of logical thinking to real life problems in a teaching and learning environment. We have used the ePBL Grid as a framework for reflection in documenting the Win-Win Spiral model. We claim that the ePBL Grid is a useful tool to guide the documentation required when adopting the Win-Win Spiral model.

## References

Boehm, B W. (1988) A Spiral Model of Software Development and Enhancement, *Computer*, vol.21, no 5, May 1998, pp 61-72.

Boehm, B W (1996). Anchoring the Software Process, *IEEE Software*, vol. 13, no. 4, pp73-82.

Boehm B, Egyed A, Kwan J, Madachy R. (1997). Developing Multimedia Applications with the WinWin Spiral Model, Proceedings of the ESEC/FSE, 1997

Boehm, B. Egyed A, Kwan J, D. Port, A Shah & Madachy R (1998). Using the WinWin Spiral Model: A Case Study, *Computer*, vol.31, no. 7, pp 33-44.

Boud, D., & Feletti, G. I. (1996). The challenge of problem-based learning. London: Kogan Page.

Bridges, E. M. (1992). Problem-based learning for administrators. ERIC ClearingHouse. University of Oregon.

Foreman, J., and T. Johnston. 1999. Key aspects of teaching and learning in business and management studies. In *A Handbook for Teaching and Learning in Higher Education*, ed. H. Fry, S. Ketteridge, and S. Marshall, 372-390. London: Kogan Page.

MBASE Guidelines (2003). *Guidelines for Model-Based (System) Architecting and Software Engineering*, University of Southern California, [Available Online]: Downloaded 29th July 2003 http://sunset.usc.edu/research/MBASE/mbase_team/MBASE_Guidelines_v2.4.0.pdf

Oon Seng. T. (2000). Thinking skills, creativity and Problem-Based Learning. In T. Oon Seng, P. Little, H. Soo Yin, J. Conway (Ed), Problem-Based Learning: Education Innovation Across Disciplines (47-55): Temasek Centre for Problem-Based Learning.

Oriogun P K, French F, Haynes R (2002c) " Using the enhanced Problem-Based Learning Grid: three multimedia case studies Proceedings, ASCILITE 2002 Conference, pp495-504, ISBN 0-473-09119-4.

Pressman, R S. (2000). Software Engineering -A Practitioner's Approach, 5th Edition, European Adaptation, McGraw Hill.

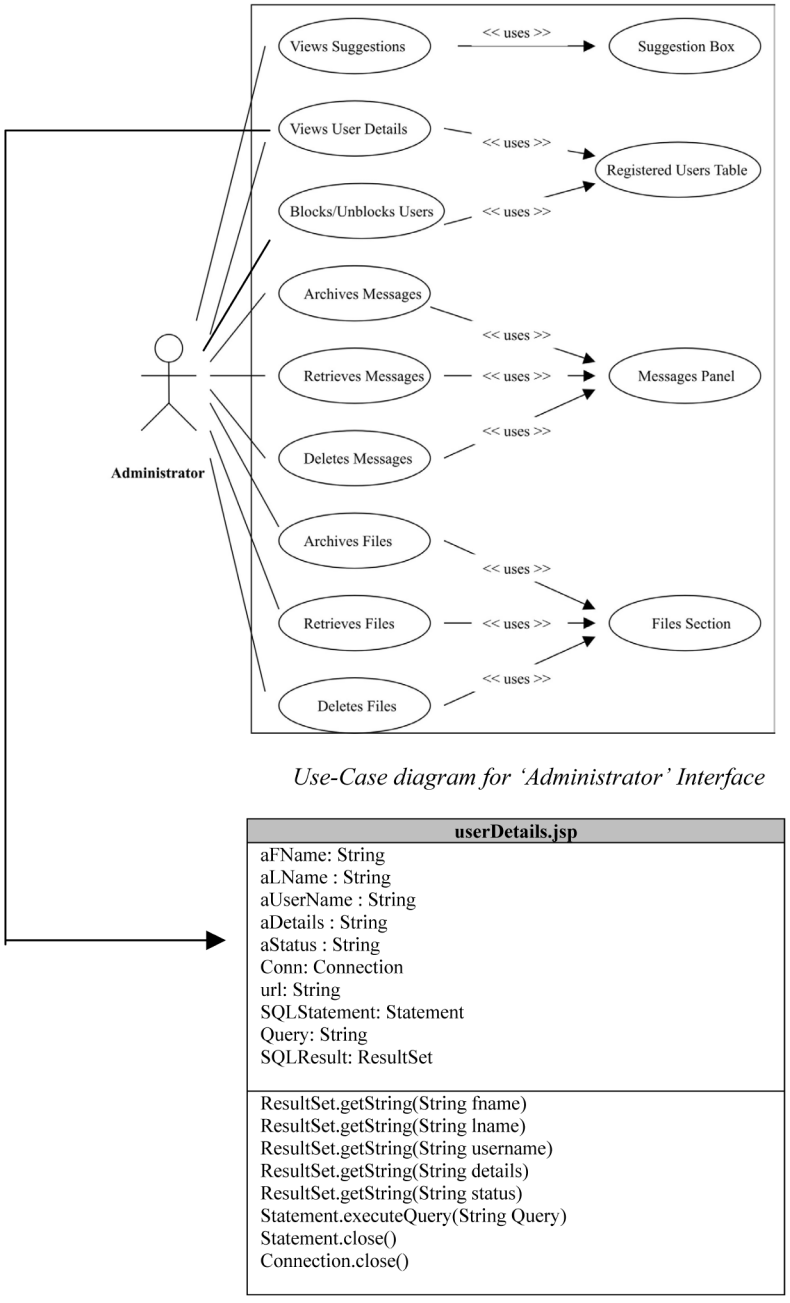
Royce, W (1995). *Software Project Management: A Unified Framework*, Addison-Wesley Publishing Company, ISBN 0-201-30958-0, pp109-155

Stevens, P., with R. Pooley. 2000. *Using UML -Software engineering with Objects and Components*, Addison-Wesley Publishing Company, ISBN 0-201-64860-1, pp29-40.

Trop L., & Sage S. (1998). Problems as possibilities: problem-based learning for K-122 Virginia: ASDC.

Woods, D. R. (1999). Workshops. In *Problem-based learning: resources to gain the most from PBL*, (Chapters B & C). Woods, Waterdown.

## **Appendix**: Use Case Diagram for Administrator Interface and the *Class Diagram for 'View User Details'*




*Use-Case diagram for 'Administrator' Interface*

Class Diagram for 'View User Details'

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