

SEABED: An Open-Source Software Engineering Case-Based Learning Database

Veena Saini¹ Paramvir Singh¹ Ashish Sureka²

¹NIT Jalandhar, India

Email: veena.sainiaug2shine@gmail.com, singhvp@nitj.ac.in

²ABB India, India

Email: ashish.sureka@in.abb.com

COMPSAC 2017

Table of Contents

- 1 Research Motivation, Aim and Contributions
 - Objectives and Context Setting
 - Related Work
 - Research Contributions
- 2 Research Framework and Solution Approach
 - Creation of SEABED Platform
 - Building up SEABED Community
- 3 Empirical Data Set, Analysis, and Validation
 - Experimental Setup
 - Sample Case
 - Empirical Analysis and Evaluation
- 4 Challenges and Suggestions
- 5 Conclusion
- 6 Future Work
- 7 References

Table of Contents

- 1 Research Motivation, Aim and Contributions
 - Objectives and Context Setting
 - Related Work
 - Research Contributions
- 2 Research Framework and Solution Approach
 - Creation of SEABED Platform
 - Building up SEABED Community
- 3 Empirical Data Set, Analysis, and Validation
 - Experimental Setup
 - Sample Case
 - Empirical Analysis and Evaluation
- 4 Challenges and Suggestions
- 5 Conclusion
- 6 Future Work
- 7 References

Case-Based Learning for Software Engineering

What is a Case?

A case is like a story, related to a real world situation that sources a number of challenging problems, which have no obvious solutions.

What is Case-Based Learning?

Case-based learning (CBL) is a **teaching methodology** based on discussing and analyzing **real world situations**.

SEABED

SEABED^a is an open source case-based learning web tool that contains a rich repository of Software Engineering (SE) cases.

^a<http://www.seabed.in>

Research Gap & Unique Challenges

Almost **No** practice of CBL for SE

- Software Engineering is a highly practice-oriented practical subject that requires decision making skills.
- There have been various applications of CBL in the fields of Medicine, Law, and Business.
- However, there are a limited number of evidences related to the application of CBL in the field of Software Engineering.

Specific Research Aim

Can we develop a web based platform where the students, instructors, practitioners, and experts enhance their SE knowledge in an effective way by implementing CBL?

Table of Contents

- 1 **Research Motivation, Aim and Contributions**
 - Objectives and Context Setting
 - **Related Work**
 - Research Contributions
- 2 Research Framework and Solution Approach
 - Creation of SEABED Platform
 - Building up SEABED Community
- 3 Empirical Data Set, Analysis, and Validation
 - Experimental Setup
 - Sample Case
 - Empirical Analysis and Evaluation
- 4 Challenges and Suggestions
- 5 Conclusion
- 6 Future Work
- 7 References

Garg et al. [3]

They exercised a case to teach the various aspects of **software architecture and design**, which engaged the learners in case solving and case listening activities, and contributed towards their communication skills.

Razali et al. [11]

They conducted a survey to prove the effectiveness of Case Methods in **SE domain** that helped the students to apply their theoretical knowledge in a realistic environment by putting themselves in the role of a decision maker.

Kundra et al. [8]

They have utilized CBL approach for teaching some important concepts of **compiler design**.

Jia et al. [6]

They presented a case study for **software design** phase.

Fuller et al. [2]

They proposed a new approach to teaching **software risk management** with case studies based on real projects which enabled the students to gain a practical experience in software development risk assessment.

Table of Contents

- 1 **Research Motivation, Aim and Contributions**
 - Objectives and Context Setting
 - Related Work
 - **Research Contributions**
- 2 Research Framework and Solution Approach
 - Creation of SEABED Platform
 - Building up SEABED Community
- 3 Empirical Data Set, Analysis, and Validation
 - Experimental Setup
 - Sample Case
 - Empirical Analysis and Evaluation
- 4 Challenges and Suggestions
- 5 Conclusion
- 6 Future Work
- 7 References

Research Contributions

Novel and Unique Contributions

- 1 We propose the first multi-featured **web based platform** for CBL in the field of Software Engineering.
- 2 We propose an approach to **build a SEABED community** and implement our proposed approach to facilitate enough activity and users around SEABED, for the platform to reach a critical mass.
- 3 We present an experimental study to evaluate the outcomes of applying CBL to the basic Under Graduate (UG) level SE course at Dr. B. R. Ambedkar National Institute of Technology(NIT) ^a, Jalandhar.

^a<http://www.nitj.ac.in>

Table of Contents

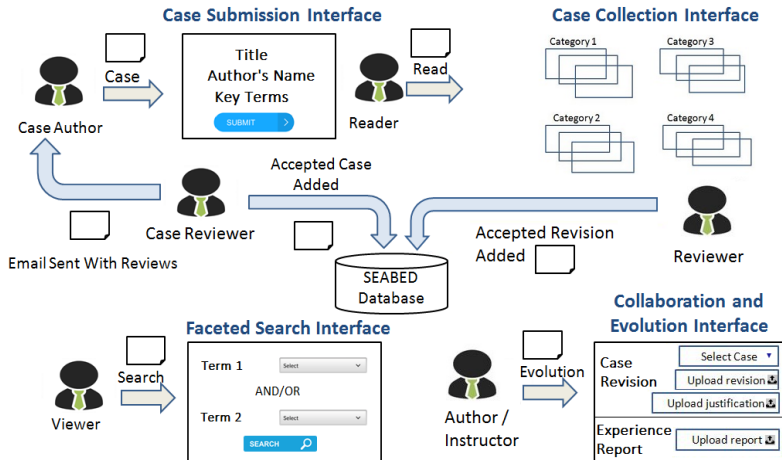
- 1 Research Motivation, Aim and Contributions
 - Objectives and Context Setting
 - Related Work
 - Research Contributions
- 2 Research Framework and Solution Approach
 - **Creation of SEABED Platform**
 - Building up SEABED Community
- 3 Empirical Data Set, Analysis, and Validation
 - Experimental Setup
 - Sample Case
 - Empirical Analysis and Evaluation
- 4 Challenges and Suggestions
- 5 Conclusion
- 6 Future Work
- 7 References

Creation of SEABED Platform

SEABED is designed using HTML, JavaScript, AJAX and PHP technologies. In addition to being a repository for the cases related to SE, SEABED has a variety of useful features. Some of them are:

- Case Submission
- Case Collection
- Case Search
- Case Evolution
- Case Collection
- Views and Opinions

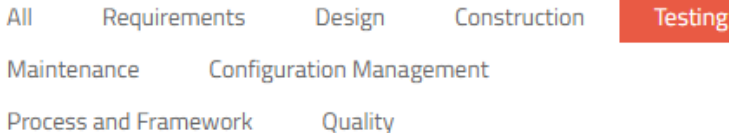
Creation of SEABED Platform: SEABED Architecture



Creation of SEABED Platform: Case Submission

<input type="text" value="Title"/>	<input type="text" value="Abstract"/>
<input type="text" value="First Name"/> <input type="text" value="Last Name"/>	
<input type="text" value="Email Address"/>	<input type="text" value="Upload Case File [PDF]"/>
<input type="text" value="Affiliation"/> Add More	<input type="checkbox"/> Provide Right To Publish
<input type="text" value="Category"/>	<input type="checkbox"/> I'm not a robot  reCAPTCHA Privacy - Terms
<input type="text" value="Key Terms"/>	<input type="checkbox"/> Notify me regarding any activity for this Case.

Creation of SEABED Platform: Case Collection



StalwartX

StalwartX (driver-less vehicle) is an emerging company with breakthrough technology. They are building autopilot and driver-less vehicles. Suppose you are a test manager at StalwartX. It is not easy to achieve self-driving capability under real world conditions and requires a lot of perfection to create a car which can make decisions on its own. For acquisition of data from its surrounding, StalwartX is embedding the cars with eight cameras and one front facing radar. The car is equipped with a super computer, which uses a self-learning process (deep learning) so that it can tackle any situation. Self-driving serviceability varies with prediction and relies heavily on comprehensive software validation and regulatory approval. These driverless vehicles are capable of controlling themselves with no or very less human interference. The security of the car heavily depends upon the team used to control this device. The car owners learn to the Staff

terms of speed or response time] through real world cases.

Topic covered in the class to undertake the study: Testing Principles, Testing Objectives, Q&A Testing, Non-functional Testing (responsiveness, performance, load, and security)

Case: Suppose you are a Test Manager of Google Chrome. Everyone can associate with Google Chrome. Google Chrome is used by millions of people on various device types of different screen size – smartphones, desktop/laptops, tablets. Chrome is ubiquitous, a full Google account integration gives you a variety of features that are not limited to a single device. Testing Responsiveness (How is the browser

Browser Case

Creation of SEABED Platform: Case Search

Term 1:

Field 1:

Term 2:

Field 2:



Search Result

Title :{StalwartX}
File Name :{Security Testing Case(StalwartX).pdf}
upload/Security Testing Case(StalwartX).pdf [Open File](#)-----

Title :{Responsiveness Case}
File Name :{Google_Case.pdf}
upload/Google_Case.pdf [Open File](#)-----

[Go back](#)

Creation of SEABED Platform: Case Evolution

Case Revision

Experience Report

#821548 ALL IS WELL CASE

uploaded by Ashish , Paramvir and Yukti on 12/14/2016

Category: Design

Key Terms: Technology Stack, client and server side framework, data security

Abstract:

AIW wants to set-up an online medical store to sell a wide range of medicines. You and your team need to select the technology stack.

[View Case](#)

[download Case](#)

[Report 1](#)

uploaded by Ashish , Paramvir and Veena on 31 Jan 2017



Twitter Case

Twitter started as a side project of some of the employees of Odeon Inc. in 2006. It had immense growth nearly 1000 % growth/year.

Uploaded by Ashish,Paramvir and Yukti on 2016-10-10



All Is Well Case

AIW wants to set-up an online medical store to sell a wide range of medicines. You and your team need to select the technology stack for development

Uploaded by Ashish,Paramvir and Yukti on 2016-...

Creation of SEABED Platform: Views and Opinions

VIEWS AND OPINIONS



In order to realize the full value of case-base teaching in the software engineering discipline an available collection of suitable cases is needed. This early effort of SEABED seems to be a move in the right direction for case pedagogy in software engineering.

---- Emanuel Grant || University of North Dakota

Building up SEABED Community

Table: EMAIL RESPONSE SHEET

Response	Instructor	Post- Doctoral Fellow	Total
Number of Positive Feedback	19	2	21
Ready for Case Submission	3	1	4
Ready for Case Revision	1	1	2
Will implement cases in their classrooms	4	0	4

Table of Contents

- 1 Research Motivation, Aim and Contributions
 - Objectives and Context Setting
 - Related Work
 - Research Contributions
- 2 Research Framework and Solution Approach
 - Creation of SEABED Platform
 - **Building up SEABED Community**
- 3 Empirical Data Set, Analysis, and Validation
 - Experimental Setup
 - Sample Case
 - Empirical Analysis and Evaluation
- 4 Challenges and Suggestions
- 5 Conclusion
- 6 Future Work
- 7 References

Community Creation Procedure

- Quality Control
- User Interaction
- Testimonials
- Recommendation System
- Promotion and Dissemination
- Guidelines and Templates

SEABED Case Template

- Objectives and Goals
- Scope
- Domain
- Level
- Size
- Relevance
- Development
- Design
- Tell a story
- Data
- Strategies
- Focus
- Create surprise
- Affirmation
- Legal Issues

Table of Contents

- 1 Research Motivation, Aim and Contributions
 - Objectives and Context Setting
 - Related Work
 - Research Contributions
- 2 Research Framework and Solution Approach
 - Creation of SEABED Platform
 - Building up SEABED Community
- 3 Empirical Data Set, Analysis, and Validation**
 - Experimental Setup**
 - Sample Case
 - Empirical Analysis and Evaluation
- 4 Challenges and Suggestions
- 5 Conclusion
- 6 Future Work
- 7 References

Experimental Setup

- The experimental study presented in this paper was carried out on a total of **89 B.Tech (UG) 3rd year** (2014 batch) students from Computer Science and Engineering (CSE) branch of Dr. B. R. Ambedkar National Institute of Technology (NIT), Jalandhar^a.
- The overall exercise was conducted by a group comprising **two faculty members, two Ph.D. research scholars and one M.Tech research scholar** from the SE domain.
- This CBL exercise was assigned a weight-age of **6 out of 10 assignment marks** for the SE course.

^a<http://www.nitj.ac.in/>

Table of Contents

- 1 Research Motivation, Aim and Contributions
 - Objectives and Context Setting
 - Related Work
 - Research Contributions
- 2 Research Framework and Solution Approach
 - Creation of SEABED Platform
 - Building up SEABED Community
- 3 Empirical Data Set, Analysis, and Validation**
 - Experimental Setup
 - Sample Case**
 - Empirical Analysis and Evaluation
- 4 Challenges and Suggestions
- 5 Conclusion
- 6 Future Work
- 7 References

Sample Case

Case Description

You are part of the SE team at **All Is Well (AIW) Pharmacy Incorporation**. AIW wants to set-up an online medical store to sell a wide range of medicines. You and your team need to select the **technology stack** for developing the online store.

- Server and client side framework
- Programming language
- Database
- Web-server
- Scalability
- Sign-in
- Data security
- Device responsiveness
- Payment methods
- Track delivery status

Sample Case

Case Questions

- 1 What are the **various parameters** that will form the basis for the selection of **appropriate technologies** or frameworks?
- 2 Identify various **requirement conflicts and ambiguities**, along with assumptions and major constraints that may potentially impact the selection of a technology stack.
- 3 Enlist the **pros and cons** of good and bad technology **selection decisions** with respect to the selection parameters.
- 4 **Justify** the selection of a particular technology stack with respect to the basic **SE design principles**.

Table of Contents

- 1 Research Motivation, Aim and Contributions
 - Objectives and Context Setting
 - Related Work
 - Research Contributions
- 2 Research Framework and Solution Approach
 - Creation of SEABED Platform
 - Building up SEABED Community
- 3 Empirical Data Set, Analysis, and Validation**
 - Experimental Setup
 - Sample Case
 - Empirical Analysis and Evaluation**
- 4 Challenges and Suggestions
- 5 Conclusion
- 6 Future Work
- 7 References

Table: SURVEY QUESTIONS GROUPED BY THE RESPECTIVE LEARNING PRINCIPLES

Learning Technique	Questions
Learning	Q1: I feel the use of case was relevant in learning about course concepts.
Critical Thinking	Q4: The case allowed me to view an issue from multiple perspectives.
Engagement	Q7: I was more engaged in class when using the case.
Communication Skills	Q9: The case discussion strengthened my communication skills to speak in front of the audience.
Team Work	Q10: The case discussion increased my confidence to work in a team.

Empirical Analysis and Evaluation

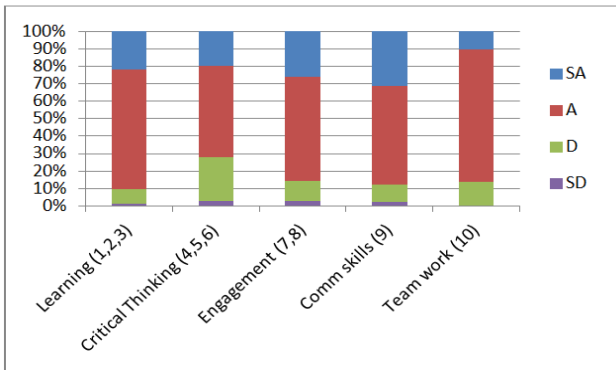


Figure: Frequency Scores for various learning principles

Empirical Analysis and Evaluation

Table: ACTUAL AND EXPECTED OBSERVATIONS

Actual		Expected	
Agree	Disagree	Agree	Disagree
80.00	08.66	74.89	13.76
62.66	24.33	73.49	13.50
76.00	12.50	74.75	13.74
78.00	11.00	75.18	13.81
76.00	12.00	74.33	13.66

- 19.33% strongly agreed(SA) and 55.20% simply agreed (A).
- On average 13.70% ($D = 12.07$ and $SD = 1.63$) disagree to have acquired the learning principles.

Challenges and Suggestions

Challenges

- Reaching out to a **critical mass**, involving and engaging the practitioners for **contribution**, and **quality control** are three of the major challenges.
- Students found it difficult to switch from lecture-based learning to case-based learning.

Suggestions

Fixing the responsibilities for individual questions.

Conclusion

- We propose a web based open source tool SEABED, based on case-based learning (CBL).
- This platform becomes useful when it reaches a wide mass of instructors willing to **contribute cases** and **implement CBL** in their classroom.
- CBL is found to be effective with an agreement of **74.53%** students who were able to understand all five learning principles of learning, critical thinking, engagement, communication skills and team work.

Future Work

- We will **add a variety of SE cases** covering problems from different software development life cycle phases to the Case Collection section.
- We also target to conduct the experimental study on **school going students** and help them to develop critical thinking skills by understanding the course concepts well.

References I

- [1] Derek Abell. Derek abell: What makes a good case.
- [2] Anne Fuller, Peter Croll, and Limei Di. A new approach to teaching software risk management with case studies. In *CSEE&T*, pages 215–222, 2002.
- [3] Kirti Garg, Ashish Sureka, and Vasudeva Varma. A case study on teaching software engineering concepts using a case-based learning environment. In *APSEC Workshop*, pages 71–78, 2015.
- [4] Chris Geddes. Achieving critical mass in social networks. *Journal of Database Marketing & Customer Strategy Management*, 18(2):123–128, 2011.
- [5] Ewald M. Jarz, Gerhard A. Kainz, and Gerhard Walpoth. Multimedia-based case studies in education: Design, development, and evaluation of multimedia-based case studies. *J. Educ. Multimedia Hypermedia*, pages 23–46, January 1997.
- [6] Yanxia Jia and Yonglei Tao. Teaching software design using a case study on model transformation. In *ITNG*, pages 702–706, 2009.

References II

- [7] Uffe Bro Kjrulff, Claus Andreas Foss Rosenstand, Jan Stage, and Mikael Vetner. *Case-based learning (CBL) - A new pedagogical approach to multidisciplinary studies*. Sense Publishers, 2008. on cd-media.
- [8] Divya Kundra and Ashish Sureka. An experience report on teaching compiler design concepts using case-based and project-based learning approaches. In *T4E*, 2016.
- [9] Carder Linda, Willingham Patricia, and Bibbb David. Case-based, problem-based learning: Information literacy for the real world. *ELSEVIER*, 18(3):181190, 2001.
- [10] University of British Columbia. Pbl network: Case writing template.
- [11] Rozilawati Razali and Dzulaiha Aryanee Putri Zainal. Success factors for using case method in teaching and learning software engineering. volume 6, page 191, 2013.
- [12] Per Runeson, Martin Host, Austen Rainer, and Bjorn Regnell. *Case Study Research in Software Engineering: Guidelines and Examples*. Wiley Publishing, 1st edition, 2012.

Founding Team



Ashish Sureka

Researcher, Educator, Writer and Programmer. Principal Scientist at ABB Corporate Research (India) and PhD from NCSU (USA)



Paramvir Singh

Assistant Professor at NITJ (India) and PhD from GNDU (India) - 11 years of work experience in Academia and Industry



Yukti Mehta

Researcher, Programmer and Intern at ABB Corporate Research (India). MTech Scholar at NITJ and BTech from IGDТУW(India)