Simulating Real-Life in Software Project alongside a Model-Based Systems Engineering MOOC

Hanan Kohen, Niva Wengrowicz, Dov Dori
Technion, Israel Institute of Technology

The 8th Kinneret Conference on Software Engineering Education
February 18, 2020
Course Goal

To endow students with the knowledge and skills related to a successful systems engineer
Course Objectives

- **To Know**
  - Model-Based Systems Engineering
  - Object-Process Methodology

- **To practice skills**
  - Conceptual Modeling
  - Communicating ideas to create common understanding
  - System Thinking which is part of Problem Solving
  - Teamwork - Cooperating (own goal) and Collaborating (shared goal)
  - Self-directed learning, autonomous learning (MOOC & project)
Course Principles

- **Flipped Classroom**
  - MOOC
  - Project

- **Project-Based Learning (PBL)**
  - Teamwork
  - Solving real-world problems

- **Simulating Real-Life**
  - Product owner (PO)
  - Customer
  - Expert consulting
Course structure

- 2 five-week MOOC courses
  - MBSE101
  - MBSE102
- Weekly meetings regarding project progress
- 5 project deliverables:
  - User story
  - System Diagram (SD0)
  - SD1
  - Project presentation
  - Final model
Course Grading Policy
(for Technion students only)

- MOOC courses - 20% each
- Software modeling project - 60% using OPCloud
OPCloud
Web based tool for modeling in OPM
Continuous being developed at the Technion’s Enterprise Systems Modeling Laboratory (ESML)

OPCloud – Implements OPM ISO 19450

https://www.opcloud.tech/

https://esml.iem.technion.ac.il/
Simulating Real-Life
Students Project Examples
About 50 projects where designed –

Navigator pane
Add the option of a small navigator screen on the canvas

Voice recognition modeling
Add support for voice recognition - OPCloud record it and complete the model

Sketch recognition
Recognize pen sketching on a touch screen of things and links

Users metrics
Create a menu with all the metrics related to the users

Help menu
Adding "interactive help" that can be turned on and off to show how features work

Create gif of a simulated OPD
Add an option to export a gif of a simulation of a model
Simulating Real-Life Practices

- Acting as PO in OPCloud Company
- Real features of OPCloud to design
- Meeting with the Customer
- Consulting experts
- User Story for the Technical team
- Design review
Project Enablers

- **Feedback on:**
  - User Story
  - System Diagram (SD)
  - SD1
  - Project presentation

- **Group collaboration**

- **Meetings with the course team**
  - PO
  - Customer
  - Modeling expert
Students’ perceptions regarding Simulating Real-Life Practices while working on Project

Preliminary Analysis
Methodology

- N=60

- Bachelor’s degree programs in:
  - Industrial Engineering and Management
  - Information Systems Engineering
  - Data science
  - Compute science

- Faculty of Industrial Engineering and Management - Technion
Methodology

Course evaluation @ end of the course (online questionnaire)

- This analysis addresses questions about:
  - Level of Project contribution to learning and understanding (1-10)
  - Project enablers (0-5)
    - User story Task
    - Preliminary modeling Tasks
    - Presentation Task
    - Group collaboration
    - Meetings with the course team
  - Course project as simulator for real-life industry project (1-10)
Project Contribution to Learning & Understanding

M = 9.1 (sd = 1.54)

Frequency (n=60)

Score (1-10)

- less than 7: 3
- 7: 5
- 8: 6
- 9: 8
- 10: 38

95%
Enablers as Project Promotors

\[ F(4,228) = 9.75, p < .001, \eta^2 = .15 \]

- User story Task: 3.46
- Presentation Task: 3.49
- Group collaboration: 4.07
- Meetings with the course team members: 4.17
- Preliminary modeling Tasks: 4.28
## Enablers as Predictors of Project Contribution to Learning & Understanding

<table>
<thead>
<tr>
<th>Contributors</th>
<th>b</th>
<th>Std err.</th>
<th>β</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>User story Task</td>
<td>.32</td>
<td>.12</td>
<td>.28</td>
<td>2.56**</td>
</tr>
<tr>
<td>Preliminary modeling Tasks</td>
<td>1.39</td>
<td>.52</td>
<td>.81</td>
<td>2.57**</td>
</tr>
<tr>
<td>Presentation Task</td>
<td>.02</td>
<td>.13</td>
<td>-.01</td>
<td>-.127</td>
</tr>
<tr>
<td>Meetings with the course team members</td>
<td>1.13</td>
<td>.18</td>
<td>.67</td>
<td>2.15*</td>
</tr>
<tr>
<td>Group collaboration</td>
<td>.89</td>
<td>.17</td>
<td>.70</td>
<td>5.133***</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R</th>
<th>.74</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R^2$</td>
<td>.55</td>
</tr>
<tr>
<td>F</td>
<td>9.98***</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>df-regression</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>df-residual</td>
<td>54</td>
</tr>
</tbody>
</table>
Course Project as Simulator of Real-Life Industry Project

Frequency (n=60)

Score (1-10)

- 1-2: 3
- 3-4: 6
- 5-6: 8
- 7-8: 24
- 9-10: 19

M=7.2 (sd=2.43)

70%
Relation Between Project Contribution to Learning and Project as Real-Life Simulator

\[ r(58) = .35, p < .01 \]
## Predictors of Course Project Simulate Real-Life

<table>
<thead>
<tr>
<th>Contributors</th>
<th>b</th>
<th>Std err.</th>
<th>β</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>User story Task</strong></td>
<td>.54</td>
<td>.25</td>
<td>.29</td>
<td>2.14*</td>
</tr>
<tr>
<td>Preliminary modeling Tasks</td>
<td>1.53</td>
<td>.110</td>
<td>.56</td>
<td>1.39</td>
</tr>
<tr>
<td><strong>Presentation Task</strong></td>
<td>.54</td>
<td>.27</td>
<td>.29</td>
<td>2.00*</td>
</tr>
<tr>
<td>Meetings with the course team members</td>
<td>.10</td>
<td>.36</td>
<td>.05</td>
<td>.28</td>
</tr>
<tr>
<td>Group collaboration</td>
<td>.32</td>
<td>.35</td>
<td>.16</td>
<td>.91</td>
</tr>
</tbody>
</table>

- $R^2 = .27$
- $F = 3.00^{**}$
- df-regression = 5
- df-residual = 54
Conclusions

- Real-Life project as significant learning scaffold
- Precise the guidelines for user story and presentation tasks
- Effective task feedback in the early stages of the project is important
- Simulating Real-Life within PBL can contribute to students’ perception regarding their learning and understanding processes
OPM Resources


- **ISO Standard:** ISO 19450 OPM

- **edX Course:** [https://www.youtube.com/watch?v=5ZhEreXtu0k](https://www.youtube.com/watch?v=5ZhEreXtu0k)

- **Website:** Enterprise Systems Modeling Laboratory contains
  - journal & conference papers,
  - free OPCAT software, upcoming OPCloud
  - presentations
  - projects
  - more...

- **OPCloud:** [https://www.opcloud.tech/](https://www.opcloud.tech/)
Visit our Lab site; http://esml.iem.technion.ac.il/

Experience OPCloud, Cloud-based OPM modeling: https://www.opcloud.tech/

Tel: +972-77-8872441

OPCloud@technion.ac.il

Enterprise Systems Modeling Laboratory 121 Bloomfield, Technion - Israel Institute of Technology Haifa, 3200003 Israel