An SE Approach for CoCo Learning of Virtual Labs

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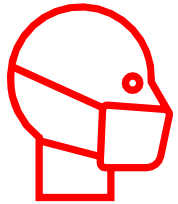
Motivation



In the current pandemic, did you figure out alternatives to make students practice lab experiments?

Do you believe in peer learning, collaborative and cooperative learning?

Do you still believe making students view videos or practice simulations is good enough to learn from online environment?

How can we make experimental learning scalable?

Traditionally, Software Engineers adopted practises from other Engineering streams.. It is time to say that Software Engineering practices brings rigour and enhances learning

Agenda

- Context Setting
- CoCo Learning Approach
- Experiment with Virtual Labs
- Results and Analysis
- Conclusion

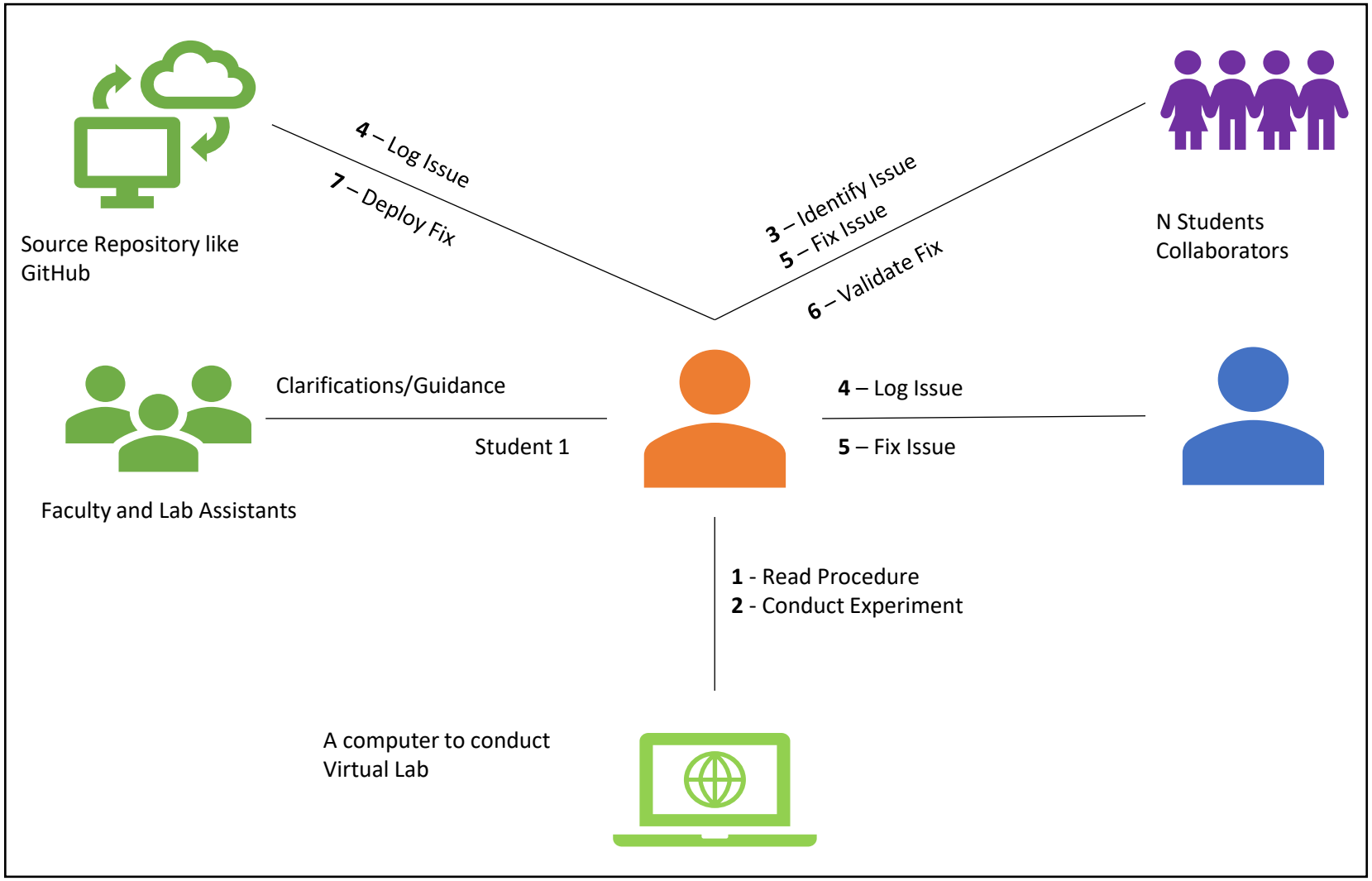
Existing Learning Methodologies

- Teacher/Student Centered
- Blended – Flipped, Problem Solving, etc
- Online and Game-based
- Collaborative and Cooperative

Collaborative and Cooperative Learning Comparison

Characteristic	Cooperative Learning	Collaborative Learning
Knowledge	Foundational	Non-foundational; A social artifact
Epistemological Orientation	Structured Instruction	Social Construction
Process	Achievement-Oriented	Course of Action
Group Structure	High/Positive Interdependence	Low/Individualistic
Teacher's Role	Micro Manager	Moderator/Facilitator/Guide
Student's/Participant's Role	Cooperative/Agreeable	Dissident/Independent
Goals	Develop Social Skills and Learning for All Members	Knowledge Construction through Conversation; Concern for Problem Solving

SE Approach for CoCo Learning



Activities in Proposed CoCo Learning

Activities	Individual	Cooperative	Collaborative
Read Procedure	✔		
Conduct Experiments	✔		
Identify Issues			✔
Log Issues		✔	
Fix Issues		✔	✔
Validate Fix			✔
Deploy Fix	✔		

Tools available for CoCo Learning

Collaboration Tools

MARUTI TECHLABS

TEAM COLLABORATION TOOLS

slack Trello asana

DEVELOPMENT AND PROJECT MANAGEMENT TOOLS

JIRA GitHub ZEPHYR

DEVOPS TOOLS

TeamCity sonar

Bitbucket

Other repositories

Students Community

OpenModelica

Virtual Labs

An MHRD Govt of India Initiative

Other Open Source Labs

CoCo Experiment – Virtual Labs

258,763
PARTICIPANTS ATTENDED

1,166
NODAL CENTRES

1,598
WORKSHOPS RUN

3,472,298
USAGE

Tweets by @TheVirtual_Labs

virtual labs Retweeted

Sri Sathya Sai Institute of Higher Learning
@SSSIHL

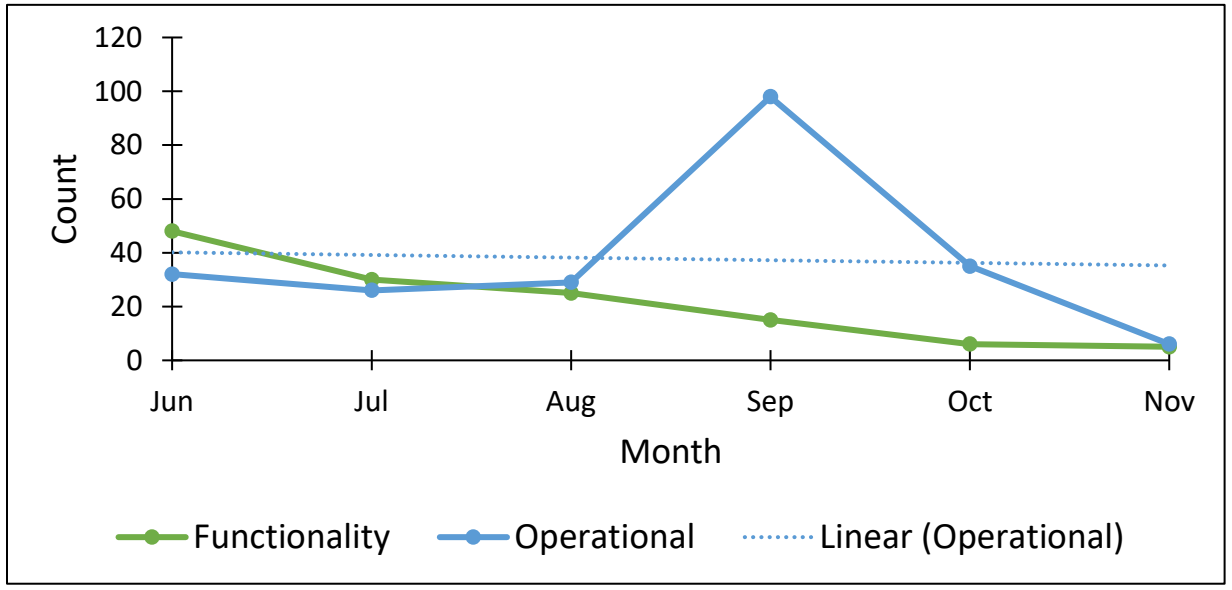
19 SSSIHL faculty learnt how to become content generators for virtual lab experiments in a Virtual Labs (SSSIHL and IIIT Hyderabad) workshop on 6 Feb 2020 led by Ms. D V N Mrudhvika. This MHRD initiative brings remote-access to Science & Engineering labs across India.#SSSIHL

Embed View on Twitter

Results of Experiment - Virtual Labs

- About 145 students participated in the experiment for 6 months duration
- Students identified 1,026 issue including 96 enhancements
- A total of 545 unique issues were identified

Issue Type	CSE	Non-CSE	Sciences	Total
Functionality Issues	108	47	29	184
Broken Links and Code Clean-up	132	81	53	266
Enhancements & New Features	58	24	13	95
Total	298	152	95	545



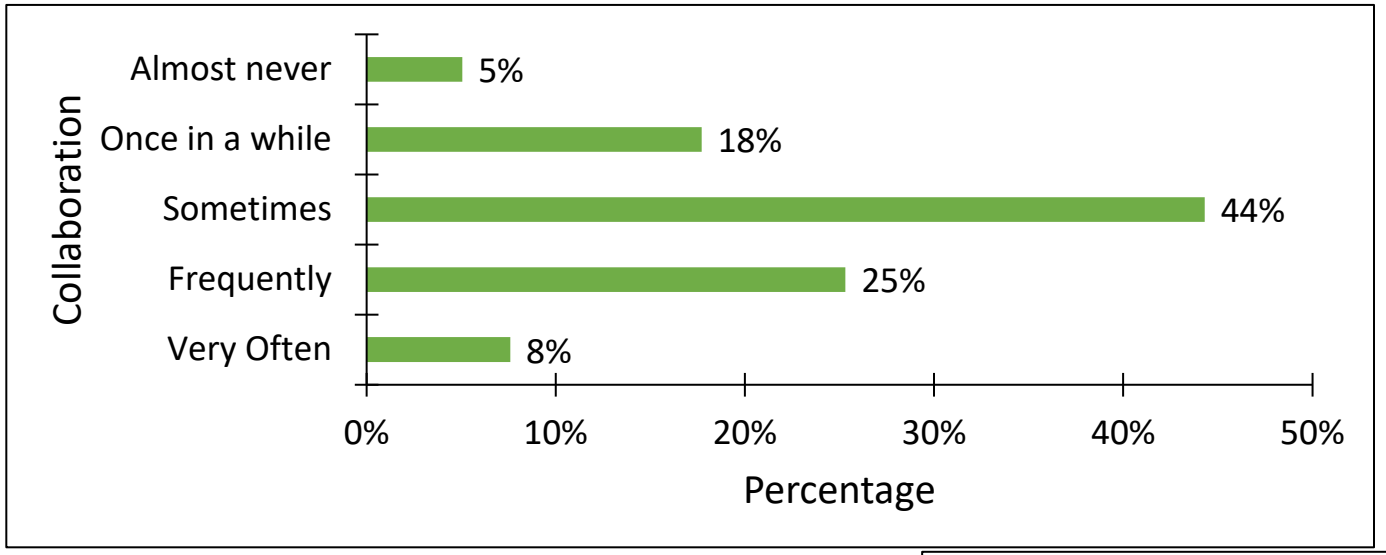
- Velocity of identification and fixes tapered
- Eleven students dropped for various reasons
- Fixed issues were also validated by students
- Functional issues took longer period
- More CSE lab issues were fixed

Fix Type	CSE	Non-CSE	Sciences	Total
Functionality	61	39	19	119
Operational	113	74	49	236
Total	174	113	68	355
% of Fix	58%	74%	72%	65%

Validation of CoCo Learning - Survey

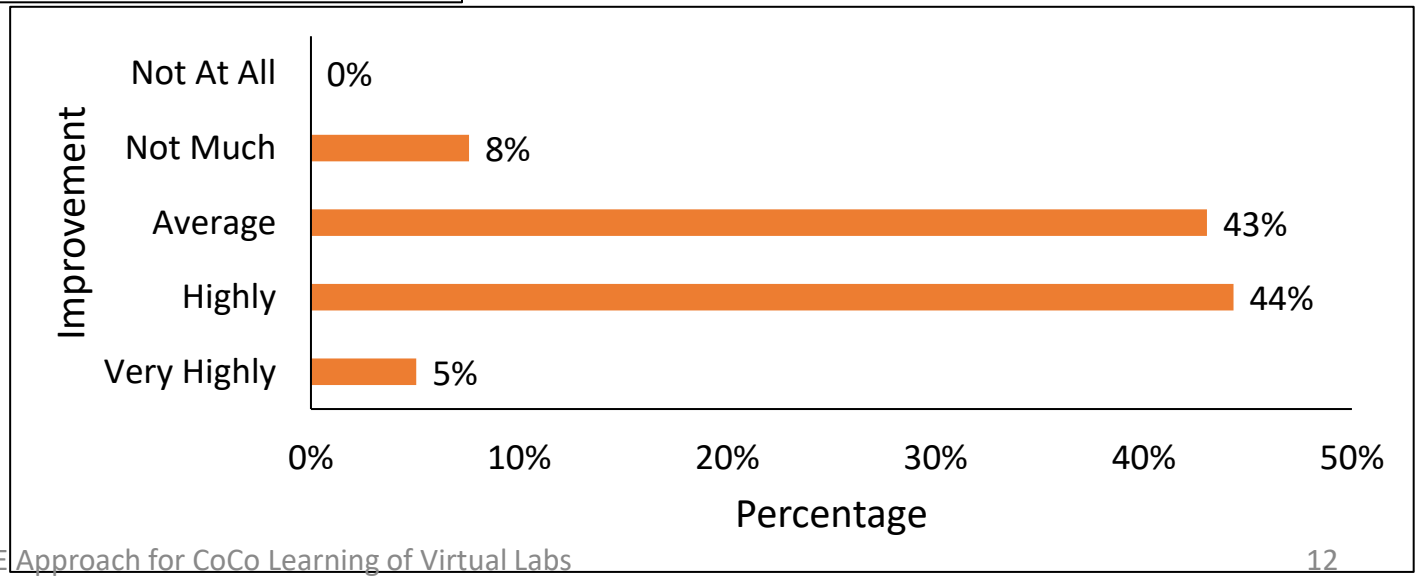
Survey	Survey Questions	Purpose
1-4	Student name, Institute name, Engineering discipline, Year of study	To bring seriousness to the survey and validity to the data for any future reference
5	How many labs (a rough count) have you tested to identify issues?	Insight on the exploration and usage of Virtual Labs
6	How many lab experiments (a rough count) have you fixed or resolved defects?	To obtain information of students who would have fixed issues but not raised a pull request in the software repository of the lab
7	How often have you interacted with students from your or other institutes to complete the task?	To obtain an insight on the need for cooperation and collaboration amongst students.
8	How much has your understanding of labs improved because of testing, fixing and interacting with other students?	Insight on the effectiveness of our approach
9	What did you like the most in these activities?	Textual response to capture comments on activities
10	What could have been better to motivate students for active contribution?	Textual response to understand other concerns or inputs on the approach.

Approach Validation - Students Survey



- About 65% of students participated in the survey. 58% of the students were junior undergraduate students
- Count of experiments conducted in Virtual Lab were more
- Sophomores were more enthusiastic as compared to others in identifying and fixing issues

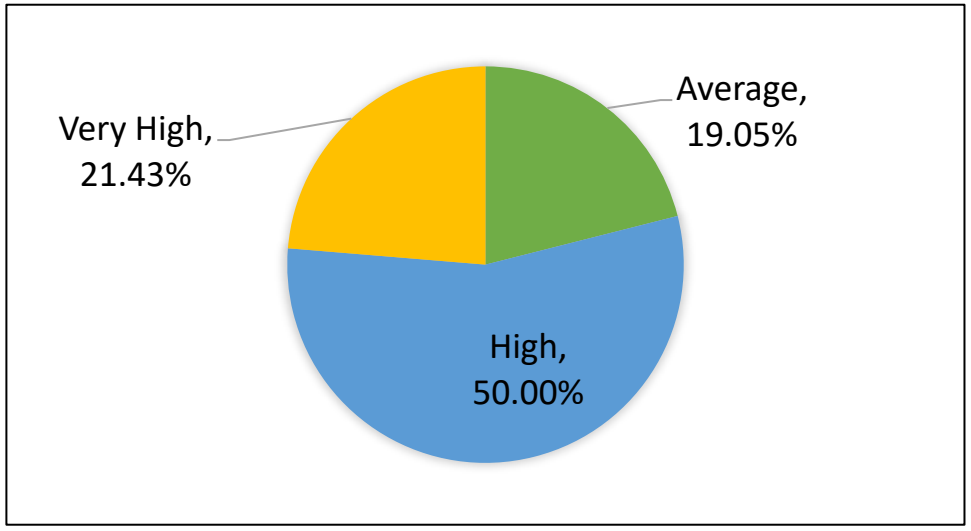
- Active collaboration by 77% of students
- More than 92% of students mentioned that their understanding had improved
- Wanted Leader board and Bootcamp for better contribution



Approach Validation - Faculty Survey

- A total of 24 faculty participated in the survey
- 90% of the faculty confirmed that students understanding of courses had improved

- Faculty liked the flexibility of “learn anytime and anywhere” with Virtual Labs
- Faculty want more Virtual Labs experiments



Benefit of the Learning Approach

Conclusion and Future Work

Conclusions

- CoCo Learning is effective and aids in teaching
- Students has flexibility to perform lab experiments
- Students learnt basics of Software Engineering and collaborative working

Lessons learnt

- Clarity is required on usage of the resources
- Students have different skill sets, tiering of tasks enhances contribution
- Train faculty and lab assistants on usage of Virtual Labs and CoCo Learning

Future Work

- Increase the count of students from other engineering or non-engineering disciplines
- Allow students to develop new labs as well, apart from using/fixing existing code base
- Validate learning effectiveness → Physical vis-à-vis Virtual

Key References and Artifacts

Key References

- Teaching in Virtual Worlds: Opportunities and Challenges by S. K. L. Riley and K. Stacy
- Does Active Learning Work? A Review of the Research by M. Prince
- Collaborative vs. Cooperative Learning: The Instructor's Role in Computer Supported Collaborative Learning by O. J. Olivares
- Computer-supported Collaborative Learning by G. Stahl, T. D. Koschmann, and D. D. Suthers

Artifacts Developed

- Virtual Labs. Available at https://vlab.co.in/
- Source code repositories of Virtual Labs. Available at https://github.com/virtual-labs/
- GitHub CoCo. Available at https://tinyurl.com/GitHubCoCo

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