

Introduction and Objectives

PLP (The Progressive Learning Platform) is a novel, open, and adaptable, multi-course Computer Engineering curriculum and technology platform. As a **material anchor**, it is designed to improve student learning by closing gaps between courses in a computing curriculum. The curricular elements of PLP provide students with soft engineering skills, especially communication skills, and provide a more hands-on classroom experience. By connecting concepts across different computing courses and providing an environment for active learning, PLP is **expected to improve the acquisition, assimilation, and retention of knowledge in computing.**

PLP's focus is in **computing**: computer science, computer engineering, software engineering, IT.

Specific courses in which PLP has been used are **computer architecture** (upper division), computer architecture (graduate), and **microprocessors** (lower division). In the future, PLP is expected to be used in operating systems, embedded systems, compilers, and logic design courses.

Developmental History of PLP

Work on PLP began in January 2010, with the initial goal of developing a platform that would provide hands-on experience for students in a junior-level microprocessors course. Student feedback (formal through course evaluations and informal through hallway conversations between me, my TAs, and the students) indicated that the students were unhappy that the course used just simulation to test their assembly programs. After carefully reviewing the options, my TAs and I decided to create our own processor similar to, but simpler than the MIPS processor.

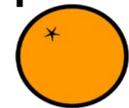
During the development of PLP and its curricular elements, my TAs and I were exploring literature on effective teaching, and I had attended several workshops on effective teaching (including NETI). Thus, PLP is heavily influenced by a number of pedagogical theories, the main ones being just-in-time teaching, constructivism, constructionism, communities of practice, and conceptual blending. It aims to merge procedural and conceptual knowledge acquisition, and connects concepts learned across different courses.

Towards the end of 2010, three members joined the PLP team from linguistics, ed-psych, and educational leadership, and in 2011, PLP was funded by NSF funding through the RIGEE (Research Initiation Grants in Engineering Education) program under EEC.

The Progressive Learning Platform for Computer Engineering



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Learning Activities and Materials

PLP has been used in a number of courses. The PLP website: <http://plp.okstate.edu/> links to some of the courses and to the PLP development site on google code.

PLP = PLHardware + PLTool + curricular materials

Details can be found in the papers listed below.

1. R. Damron, S. Sohoni, K. Kearney, Y. Cho, "Impact of PLP on Student Learning: Initial Results", ASEE Annual Conference, Atlanta GA, June 23-26, 2013
2. W. Mulia*, D. Fritz*, S. Sohoni, K. Kearney, M. Mwavita, "PLP: A Community Driven Open Source Platform for Computer Engineering Education", International Journal of Engineering Education, vol 29, issue 1, pp 215-229, 2013
3. S. Sohoni, D. Fritz*, W. Mulia*, "Transforming a Microprocessors Course through the Progressive Learning Platform", ASEE Midwest Section, Russelville, AR, September 2011
4. D. Fritz*, W. Mulia*, S. Sohoni, B. Gordon*, K. Kearney, M. Mwavita, "The Progressive Learning Platform for Computer Engineering", Proc. of ASEE National Annual Conference and Expo (ECE Division), Vancouver, Canada, June 2011
5. D. Fritz*, W. Mulia*, S. Sohoni, "The Progressive Learning Platform", Workshop on Computer Architecture Education in conjunction with HPCA-17, San Antonio, TX, February 2011

Term	Course Number	Pre-Post Quiz	Student Reflections	Focus Group	Pre-Post Mindsets	Wiki	Video of Lab	Student Peer Eval
S 2010	ECEN 4243	X		X				
S 2011	ECEN 4243	X		X		X		X
F 2011	ENSC 3213	X	X				X	
S 2012	ECEN 4243	X	X			X	X	X
S 2012	ENSC 3213	X	X	X		X		X
S 2013	ECEN 4243	X	X		X	X		
S 2013	CST 250	X		X	X			
S 2013	CST 364	X	X		X	X		X

Major Issues to Resolve

Classic mistakes: Collected too much data (shown above), did not have a clear experimental design, research questions were too broad.

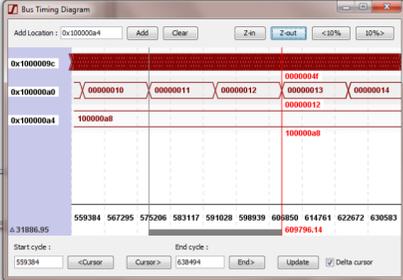
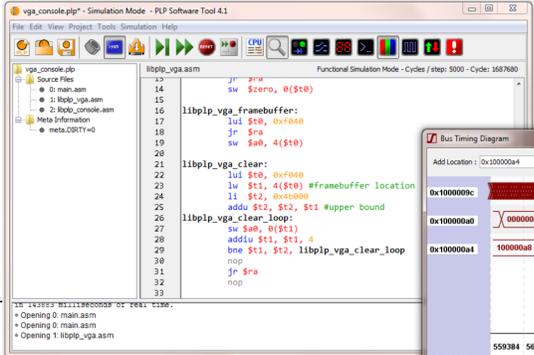
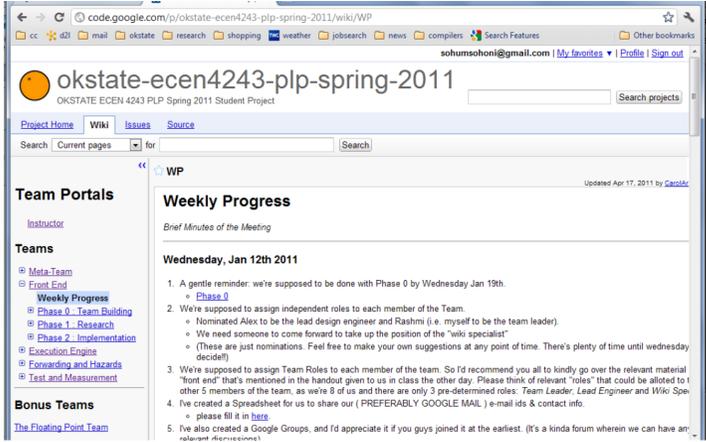
Original Research Questions- we have data/results for those in green.

1. How effective is PLP in changing student motivation?
 - a. How does PLP change student mindsets, and what are the underlying reasons for its success/failure?
 - b. How does PLP enhance students' academic efficacy?
2. How does PLP improve student learning?
 - a. How effective is PLP as a material anchor, and why?
 - b. How well does PLP facilitate a Community of Practice?
3. How does examining students' language in written and oral reports help to explain their conceptual understanding and their attitude/mindset?

Coding the reflective essays and other qualitative data has taken an inordinate amount of time, and the data analysis has been a bottleneck. We not had time to even look at Spring 2013 data, which is the only data point which has student in a PLP-based course who have been in a prior PLP-based course. This is a critical data point for our study.

At FOEE, I would like to get **feedback on our current methods and findings to see how we can improve the experiment and methods.** Specifically, it has been hard to separate PLP's impact from all that PLP facilitates- the active learning, the instructor's enthusiasm etc. Are we just asking the wrong questions? What questions should we ask?

I would also like to find **potential collaborators interested in conducting research with PLP as the vehicle.** This will generate more data on PLP's impact on students' acquisition, assimilation, and retention of knowledge in computing, but we will budget for it through an NSF REE grant.



Discussion: Conclusions and Future Work

Research: Initial results show that **students perceive PLP to create an authentic learning experience which promotes a high level of engagement.** Results also show that **students are independently drawing on concepts from different courses and connecting them to apply in their projects.** As an instructor, it is a joy to practice contextualized just-in-time teaching using PLP. The TAs have also enjoyed teaching with PLP.

I expect that broad adoption of PLP will have its own set of challenges. While it is crucial that we demonstrate PLP's effectiveness in the classroom through rigorous well-designed experiments, and publish our results in high-impact journals, we could still face the valley of death. To facilitate adoption, we are working on a new, well-organized website to host curricular material for each course that PLP supports. In addition, I will reach out to potential collaborators for early adoption, as they could also become part of the research experiment. I will present PLP at various venues such as this one, ASEE, FIE etc., and to pursue collaborations through joint funding ventures similar to TUES-2 or Cyberlearning diffusion. It will be interesting to study what barriers we face for adoption.

Spinoffs: 1) Tie-up with a foundation or start an LLC to provide low-cost new texts and learning modules based around PLP. 2) Tie-up with a foundation and with Digilent to distribute FPGA boards in developing nations and to the financially disadvantaged in the US. 3) Collaborate with IUCEE and other such organizations to run webinars teaching faculty how to use PLP and explaining the advantages of using it.

PLP is open source and distributed under GPL 3.

Acknowledgments

This material is based upon work supported by the National Science Foundation under Grant No. EEC 1136934. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.



2013 Frontiers of Engineering Education

Irvine, California
October 27-30

Sponsored by:

The National Academy of Engineering and John McDonnell and the McDonnell Family Foundation



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