Flipped Classroom: A coderdojo perspective.

**Dr Bheemaiah Anil Kumar, CoderDojo St Paul2 ,
Alumnus Dept of Electrical Engineering IIT Chennai,
India.
st.paul2.us@coderdojo.com**

Abstract— The coderdojo movement is a grassroots literacy movement to bridge the digital divide using a flipped classroom, similar to edx and most corporate education. In this paper we describe the alternative learning experiments at a coderdojo at St Paul MN, USA, where we used AWS education to teach many streams including SLAM, robotics, web design, hardware designing, circular economy and operating systems. Future work includes flipped teaching of python and mathematics at the graduate level and adoption of flipped learning at universities.

Index Terms—education psychology, constructivism, dojo, active learning, flipped school, pbs learning media, raspberry pi, arduino, cost effective soc based computers.

I. INTRODUCTION

What:

1. A comprehensive listing of raspberry pi projects for a coderdojo.
2. A comprehensive listing of suggested videos from pbs and popsci.
3. A comprehensive listing of suggested reading material.
4. A review and discussion of present, past and future flipped classroom experiments at Coderdojo St Paul MN

A flipped classroom is an instructional strategy and a type of blended learning focused on student engagement and active learning, giving the instructor a better opportunity to deal with mixed levels, student difficulties, and differentiated learning preferences during in-class time.

[Wikipedia](#)(Contributors to Wikimedia projects, 2011)(Tucker, 2011)

II. Background.

(*Myths and Facts About Flipped Learning*, n.d., *Research, Reports, & Studies - Flipped Learning Network Hub*, n.d., *View of The Impact of the Flipped Classroom Model on Students' Academic Achievement | The International Review of Research in Open and Distributed Learning*, n.d.)(Brame, 2013)The minimal viable definition for a flip learning experience would constitute.

1. The existence of a flipped classroom or instructional strategy with didactic lectures or classroom teaching replaced with any form of active teaching strategy.
2. Homeworks, assessments are a learning experience held only during instructional settings in the classroom.

By these minimal definitions, the coderdojo dojo sessions are proven to be a flip active learning experience. By academic definitions, by CIRTL, (*CIRTL Network Commons*, n.d.) Learning objectives and Learning as Diversity, apart from teaching a s research experiences are axiomatic in Coderdojo Instruction. Every activity has clear learning objectives defined and diversity definitions are found in [(*The New CoderDojo Facilitators' Guide!*, n.d.)].

Fig 1: Screenshot of Learning objectives of an example coderdojo activity.([No Title], n.d.-a, [No Title], n.d.-b)

Higher Learning.([No Title], n.d.-c)

“University of Washington Scott Freeman, a popular instructor at the University of Washington in Seattle decided that despite good student evaluations for his gateway biology class he needed to improve his course’s 17% failure rate.

He knew the problem lay in his students’ inability to critically apply the knowledge they absorbed in lecture. Eager to try something new, he adopted the Flipped Learning model for his course by having students complete textbook readings and take online quizzes before class. When students arrived in class he tested their comprehension by having students respond with hand-held clickers to questions on the material. He then asked them to turn to their neighbor to justify their answers.

This model of learning, known as peer instruction, has been advocated by Harvard professor Eric Mazur for over a decade and is a common classroom activity in a flipped course. He was able to reduce his failure rate from 17% to

4%, and the number of students performing at an A level has increased from 14% to 24%. Since the flip, the UW “Honestly, Biology 180 was a refreshing change from all the classes I have been taking at UW. I not only learned a lot more in this class, but I was able to retain a lot of it even after the exam.” -Mustufa Jafry, student in Dr. Freeman’s flipped course majoring in biochemistry and chemistry, University of Washington in Seattle professor continued to receive positive feedback from his students who recognize that his course works differently than traditional lecture classes.

The University is now offering support for other teachers interested in flipping their classroom through their Center for Teaching and Learning.

Source: Washington college instructors are ‘flipping’ the way they teach. The Seattle Times. December 16, 2012. Retrieved at bit.ly/YcstDH”

“University of British Columbia Physics instructors at the University of British Columbia in Vancouver, Canada decided that they wanted to test a method of teaching that could better engage their undergraduates in large lecture courses (with over 250 students in each section).

They created a formal experiment in which the same physics course would be taught by two experienced professors in the traditional lecture format up until the last week of the semester.

During the last week two new, less-experienced instructors came in to teach one of the classes in an interactive flipped style while the other class maintained the same professor and traditional lecture style. In the flipped class, students read over textbook pages and then took an online quiz before class, using class time to answer questions with peer discussion groups, perform small-group active learning tasks, and receive personalized feedback from the instructor.

The instructors, including 2011 Nobel Laureate Carl Wieman, found that in the experiment students in the flipped section increased attendance by 20% and that engagement, as measured by four trained observers, increased by 40%.

Even more impressive, they found that students in the flipped course scored more than twice as well as students in the control group on a multiple-choice test measuring comprehension of the content in the final week¹.

Students also enjoyed the flipped experiment: 90% agreed that they enjoyed the interactive learning methods tried in the last week. The instructors concluded that using these active learning methods in a flipped course can improve both learning and engagement.

¹ According to the study published in the prestigious peer-reviewed Science magazine, “The average scores were 41 +/- 1% in the control section and 74 +/- 1% in the experimental section. Random

guessing would produce a score of 23%, so the students in the experimental section did more than twice as well on this test as those in the control section.”

Source: Improved Learning in a Large-Enrollment Physics Class. Science. May 13, 2011. Retrieved at bit.ly/m9an4V”

“University of Michigan at Ann Arbor One of the biggest challenges of learning math in the traditional lecture model is that students must perform the most difficult task - solving practice problems - outside of class where they have no help from their peers or instructor.

Realizing this the math department at the University of Michigan at Ann Arbor flipped their mode of instruction for their introductory calculus courses allowing instructors to guide students through the exercises and clear up misconceptions before they become bad habits. In class students are asked to present their answers to their peers or work in small groups.

Instructors in the math department sought to ensure that students understand the key concepts behind calculus, rather than simply be able to solve template problems. To do this they use a 22-question “concept inventory” test that measures comprehension of underlying concepts. When they compared student performance on the same pre- and post-tests between their flipped courses and traditional courses, they found that students in their flipped course were able to make gains at twice the rate.

Source: How ‘Flipping’ the Classroom Can Improve the Traditional Lecture. Chronicle of Higher Education. February 19, 2012 Retrieved at bit.ly/l4Shaq”

II. Methods:

CoderDojo, adopts Flipped Learning, a form of active learning pedagogy in its roots in constructivism and gestalt. Reference videos and reading material are listed online with Dojo sessions where mentors guide the students called ninjas, in constructivist exploration and learning of topics in software and hardware using a variety of computing platforms, including raspberry pi hardware.

At CoderDojo St Paul², software engineering was taught with architecture, migration to cloud and IaC, CaC and MaC and Kanban, Lean Management.

III. Core Thesis:

Active learning pedagogy, improves learning retention, makes the subject more approachable and likable, and renders the subject in a minimalist and a simplism which has a universal appeal.

This encourages self learning in constructivism and in self exploration and guided exploration, towards a better grasp of the fundamentals of the subject.

To summarize, active learning, has been proven in studies:

1. To increase comprehension, in quantitative measures in a classroom setting.
2. Improve participation and attention spans in classroom settings.
3. Lighten the burden of the student community, using online and electronic mediums.
4. Improve creative pursuits in increased self learning, exploration of out of the syllabus topics, improve the accessibility of higher learning and academics, bring EdTech education and real life scenarios into the curriculum.

IV. The Dojo Experience.

1. SLAM technologies were taught at CoderDojo St Paul2, to create the Tiny Bat™, an ultrasound based point cloud, in lieu of an imaging camera to respect the privacy of subjects living in ecological domains where tiny bats survive on electric fuel.
2. The Learning Objectives for this EdTech course are:
A student will be able to:
 - a. Understand and apply the mathematical theory of SLAM, and the integration of a sensor network to a SLAM system.
 - b. Read, understand and modify using JIRA, a scrum application, and a UML tool, the source code and cloud functions, GPS integrations for core SLAM, a minimalist version of SLAM in python.
 - c. Design the extensions needed for the TinyBat™ project.
 - d. Understanding Deep Learning Networks and use of cloud functions in the integration of deep learning to mobile SLAM systems.

The Dojos involve exploration of deep learning, GPS and cloud integration to ready hardware, such as the pixhawk and resnet based cloud integrations for persistence of the point cloud and image reconstruction.

RGB-D imaging with depth cameras for metric imaging and mapillary persistence of images is also taught for terrestrial robotics. This experiment is ongoing with excellent participation and results online.

The very existence of the coderdojo movement based on traffic statistics from coderdojo.org website and other sites, proves conclusively the efficacy of the pedagogy of active learning. These topics are far beyond the realm of traditional educational curriculum and prove active learning as generating out of the box thinking and self exploration and learning, the need of the hour, in scientific progress and progress in A.I technologies of trans-humanism.

3. Teaching Python.

AWS Lambdas are authored in python migrating raspberry pi projects to the cloud, with lambdas and IaC, teaching software engineering using Kanban and Jira.

The learning objectives for this Edtech course are.

1. Learning to migrate to the cloud, using coderdojo examples.
2. Rewriting a thread of control with a CloudFormation Template for a Lambda.
3. Learning event calculus and adding triggers to AWS Lambdas.

V. Discussion.

The CoderDojo is an example of constructivism, in practice and based on web usage statistics of coderdojo and raspberry pi statistics, it is proven a viable and successful form of active learning.

The active learning at coderdojo stpaul2, is an example of active learning in practice to teach advanced A.I , like SLAM systems, in practical applications like auto navigation systems. Future work involves undergraduate and graduate active learning experiments using the NumWorks calculator in teaching the Python Language and AWS Lambdas using AWS Chatbot and Slack integrations.

VI. Resources:

1. Pbs Videos.
[Nature Cat Engineering & Technology](#)
2. [SciPop Videos.](#)
3. [TED talks.](#)

VII. Raspberry Pi Project Resources.

1. [Raspberrypi.org](#)
2. (*Raspberry Pi Projects*, n.d.)
3. (*101+ Raspberry Pi Projects*, n.d.)
4. (*audreyobscure*, n.d.)
5. (*Hackster.io*, n.d.)
6. (*30 Cool Raspberry Pi 4 Projects for June 2020 | All3DP*, 2020)

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