

Report on the Usage of Maker Labs in Education

— An Active Learning Approach to ESL and ICT —

教育におけるメーカーラボの使用方法についての実践

— ESLとICTへのアクティブラーニングの手法 —

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Abstract : This report describes the growth of maker lab and fabrication laboratory in both the private and educational sphere. Maker lab are flexible space where students can create real objects and explore the concept of physical computing. It is also a unique space to offer practical English education.

要旨 : 本稿では、私的な領域と教育活動でメーカーズラボと加工ラボラトリーの発展していることについて説明する。メーカーズラボは臨機応変な空間であり、学生が本当の事物を作ることが出来、コンピューターの物理機器の概念も調査出来る。また、実物教育のため独特な空間を提供する。

Keywords : ICT, active learning, coding, making, EFL

1.0 Introduction

The goal of this report is to examine new trends in active learning and explore new avenues for students to improve their English in a project based classroom. We have already experimented with project based learning in the media 1 and media 2 classes currently offered at IPU and we are interested in pushing the experience further.

Our students are obsessed by screens and countless ways to escape reality, yet it has never been easier to create real objects. When confronted with a real life puzzles, students are forced to collaborate and be creative.

In the past year, I have been researching the benefits of makerspaces in education and we believe that IPU students would greatly benefit from a basic introduction to maker's technologies.

2.0 Current offering of active learning classes taught in English at IPU

International Pacific University offers a limited number of "content" classes taught in English. The current offering is comprised of media 1, media 2, Practical debating skills, English TV and Movie, English Media and English Education, Business 1-2-3 and current English.

Among these classes, media 1-2, debate and English media are the only classes that offer a truly active learning approach. In media 1 the students create their own personal blog on Wordpress and record a podcast. The media 2 class offers the students the chance to learn how to create their own Youtube channel.

In both of these classes the students get to practice the four skills (reading, writing, speaking, and listening). They learn essential Information and Communication Technology (ICT) skills in a creative and collaborative environment. These classes demand

a lot of work from the students. The evaluation for these classes is based on the student production of blog posts, videos or audio recordings.

Students from all departments would benefit from having attended these classes. The skills acquired producing could also be useful in their respective fields of study. Both education and business students could benefit from learning how to create and publish their own content on multiple platforms.

3.0 Maker's labs and fabrication labs

What is a maker's lab? Like the name might suggest, a maker's lab is a space where you make things. There has been a revolution in how objects are created and fabricated in the last 20 years and schools and universities are a hotbed of creativity where students can now prototype and produce what they could have only dreamed of a few years ago. The margin between what professional fabricators and amateurs can make is shrinking every day.

The objects made in a maker's lab range from the smallest figurine to complex mechanical parts used in building satellites. The labs are often defined by the flexibility they offer. Students studying anatomy can produce 3D prints of bones or a model of an organ.

Inexpensive prototyping computers such as the Raspberry Pi and the Arduino platform have opened new avenues where anybody can create robots, automated systems, sensors, or new machines inexpensively.

3D scanning, 3D software and 3D printing are revolutionizing the concept of producing objects and are available to students to use in the context of the classroom. We will explore in more details all these technologies and see how they could be taught in English to all IPU students.

4.0 Maker's labs in Japan

Following the global trend, maker's labs are appearing all over Japan. These labs are aimed at children, hobbyists and entrepreneurs

Some of these maker's labs will let upcoming entrepreneurs prototype new products for a fraction

of the cost of the traditional method. While other countries have taken advantage of this emerging market, Japan remains a country where the industrial production of high quality equipment and objects could benefit from this quick prototyping environment.

China is currently offering an environment where products can be prototyped in a few days, tested, and mass produced for the global market. This approach follows closely the trend of deploying new ideas quickly and seeing how they fair in the real world. The real-life prototype can then be tweaked, modified and after a few iterations, mass produced. Maker's labs are a rich environment where designer can rejuvenate Japan's manufacturing.

There is a point where the needs of Japanese industries and the education providers intersect. Both schools and companies can benefit from introducing classes by providing students the skills and the mindset to succeed.

5.0 Maker's labs in education

A maker's lab is the perfect STEM (science, technology, engineering and mathematics) environment where the theory taught in science and math can be concretely applied. Computing and programming classes when combined with even a modest maker's lab can

Traditionally, schools would offer wood or mechanical classes to their students. Students can now 3D print small machines or even create their own robots.

Maker's labs come in all sizes and can easily be built from scratch. The lab is adapted to the needs of the students, will it be mechanical engineering, architecture or industrial design students.

The simplest of these labs can still play an important role in introducing students to cutting edge manufacturing methods.

6.0 The digital becomes physical

Traditional educational methods often require a high level of abstraction. The advent of ICT in

education has offered teachers the possibility to illustrate these concepts. Pairing a computer with a projector is an easy way to access the infinite resources of the internet.

Maker's labs are pushing the boundaries of the digital by making what could only be visualized on the screen into real physical objects. Such an environment is conducive to creativity, innovation and experimentation.

7.0 First steps into physical computing and computational thinking

The task of setting up a fabrication lab might seem daunting and the cost may appear prohibitive. These labs are often supported by users who will pay an hourly or monthly fee to use the lab.

Computational thinking can be introduced on a limited budget with the use of the Raspberry Pi computer and the Arduino development board.

The Raspberry Pi is an inexpensive board computer invented by computer scientist at Cambridge University in the United Kingdom in order to provide an inexpensive platform for children and amateurs to learn computing. The current Raspberry Pi can be bought for 35\$ and will support more than 17 operating systems and has the capabilities to be expended through the GPIO (General-purpose input/output). Raspian, the most common operating system for the Raspberry Pi offers students a number of programming environment, educational games and a full productivity suite.

The Arduino is an open source microcontroller which allows the user to control or interact with devices and sensors. Arduino are often used in automation projects, robotic, IoT (Internet of things) or to control things as simple as a single LED.

Both the Raspberry Pi and the Arduino offer a low floor and a high ceiling (Resnick, 2017) by letting novice and expert users find projects which are tailored to their knowledge and interest.

8.0 Robotics

Robotics in education have evolved considerably

in the last few years. Learning to program a robot has become much easier with the introduction of block programming. Block programming is done by stacking function blocks inside a visual interface. This click and drag approach has proven itself to be a revolution in the world of computing education by lowering the entry level to the field of robotic.

There are numerous players in the field of educational robotics. For example, Lego Education with their Mindstorm robot, which was created by the Learning Lab at the MIT Media Lab. The Mindstorm robot is compatible with all Lego blocks which lets children expand their project.

Makeblock, based in Shenzhen, China, offers a cheaper alternative to the Mindstorm robot and will let students program their simple robot with block based interface or other higher level language like Python. These tools are highly adaptive and can be used to teach beginners or PhD students..

Public schools in the United Kingdom are currently offering computing classes at the elementary level and companies have been quick to offer support. The BBC (British Broadcasting Corporation) has introduced the micro:bit programming board. The micro:bit board is easy to use for small children and despite having a limited interface of 25 led lights, can be used to create games, compose music or control a small robot.

Computational thinking skills can also be taught on paper or with simple blocks. Companies like Primotoys are introducing ways for children as young as 3 years old can begin playing with the concept of coding and debugging simple codes.

9.0 Computational thinking

Programming in school in recent years has been viewed as a new way to approach thinking. The goal of programming classes is not for all students to become programmers, but to give them an equal chance to explore their creativity and understand the language which fuel the technologies which we use every day.

We therefore believe that computational thinking could help IPU students with their future career.

10.0 3D scanning and printing

The price of 3D printing is constantly dropping and is becoming widely available. Introducing 3D printing in the classroom has become a necessity. While 3D printing may seem like a trivial activity, 3D printing is underlying an industrial and scientific revolution.

3D printing will soon revolutionize the way we consume product. Imagine a world where you can walk down to a store and they will 3D print pretty much any object you desire. Companies like Adidas are already experimenting in this field at their Berlin flagship store where it's possible to get a 3D scan of your body and a machine will then proceed to 3D print a shirt which will be unique and fit perfectly.

This idea is especially important for our business students who need to understand clearly the modalities of industrial production. The idea is not to make them proficient fabricators but to give them enough knowledge to be able to interact with engineers and programmers in the future.

11.0 IoT (Internet of Things)

IoT or connected objects are the next step in ambient and omnipresent computing. Japan is one of the leader in the field of IoT and the students would greatly benefit from a basic introduction to IoT.

Both Raspberry Pi and Arduino which we previously mentioned can be used to introduce IoT to students.

SONY education has recently introduced an educational tool to teach IoT, the SONY MESH is an easy plug and play tool which lets student interact with different sensor and learn how to control them from their smart devices.

Teaching IoT can help students understand how the future of connected devices will affect their daily life. The nature of the educational IoT is such that student can create working projects in the matter of minutes.

IoT in the classroom is also a great tool to teach basic functional English in the context of an **IFTTT** (if this, then that) programming environment. For

example, the student opens the door, a motion sensor triggers the shutter of a camera located in the classroom or a temperature sensor can send an email to the teacher's phone when the classroom is too hot or cold.

12.0 Conclusion

Fabrication labs and maker's labs are growing in popularity all over Japan and they will eventually permeate the world of education. How quickly will our university become a part of the movement? We have already started exploring the possibilities of using the Raspberry Pi and other devices in teaching basic computational thinking knowledge. We are looking forward to the possibility of setting up a dedicated space for IPU students to experiment and learn about new technologies.

The amount of work it takes to create a maker's lab may seem discouraging but the benefits for the students clearly overshadow the difficulties.

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