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碩士論文

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創造力教學融入程式設計教材設計與編撰

Course Ware and Teaching Method Design with Creative Thinking for Programming Course

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摘要

程式設計是屬複雜性工作，許多學生於學習過程中，在參與訓練課程裡，往往會碰到許多問題與障礙，包含不同程式語言設計、數學邏輯問題、資料庫存取問題以及網路通訊障礙，因此在學習的過程中，往往因為不同問題，涉及許多認知技能及相關因素。程式設計的教學目標是要讓學生根據程式語言的語法、語言結構與設計技巧來解決問題。然而傳統課程設計過程中，電腦程式教學模式大多採用示範性教學，依循程式習題示範步驟進行教學，此部份所提供的訓練，為複製學習法則，學生往往於課堂內參與教師實務操作演練後，無法自行思考其他問題解決能力。

因此，如何透過教學模式融入電腦程式教學活動，培養學生先行學會瞭解問題，瞭解他人軟體開發流程與架構，透過操作過程中，仿造學習開發，瞭解如何建構軟體設計與功能服務平台，同時目標將培養解決問題能力，成為改進學生程式設計學習成效一項可行手段。

本論文之研究目標在於融入創造性問題解決訓練(Creative Problem Solving)，透過觀察法，先瞭解問題發生原因，充份思考，並運用 Generating Ideas 想法概念建立，訓練學生在碰到一個系統軟體開發計畫時，能全面思考預定構思解決問題方法，最後透過 Planning for Action 實務規劃執行，完成最終預定解決問題方法規劃建立。完整培訓出學生對於程式軟體開發過程中，除了學習如何開發之外，訓練中更加強化創意問題解決思維概念。最終達到完成以軟體程式設計為核心，建立課程重新設計規劃、建構學生學習動機並研究預期解決問題設計、跨校學習成果評比以及學生創造力指標研究。

關鍵字：創造性問題解決訓練，課程設計，程式設計

Abstract

Programming learning is a complexity work, many students in the process of learning often encounter many problems and obstacles. Programming faces different programming language design, mathematical logic, database access and network communication barriers, therefore in the process of learning. Due to these different issues, Programming involves many cognitive skills and related factors. The teaching objective of programming is to teach the students using the programming language syntax, language structure and design technique to solve the problem.

However, the traditional curriculum design and process, the computer program teaching methods mostly adopted the demonstration teaching, followed by demonstration teaching steps. Most of students were not able to the capability of problem solving. Therefore, how to incorporate creative thinking into the programming language teaching activities and to cultivate students learn problem solving skills is the main objective of this thesis.

The objective of this thesis is to integrate creative problem solving training into programming teaching, through the method of observation, understand the problem first, fully thinking, and using the generating ideas concepts. We train students through a system software development project. It will involve comprehensive thinking using problem solving method as well as action planning practice, training students through a whole software development process. In addition to learning how to develop program, the concept of creative problem solving thinking is enhanced in the process.

This thesis will have curriculum design, which will improve students learning motivation and study.

Keywords: Creative Problem Solving, Course design, Programming

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Chapter 1. Introduction

1.1 Preface

Programming is the basic of building and achieve Information Technology, however in practical information education we found that students programming skills has not improved through education improve plans or education improving methods past these years. Instead, student gets extremely bored learning kinds of programming grammars and structures, not enable to apply and implement programming to daily life.

In order to enhance and train students take the initiative to explore, research and prospect discussing interactive education design, encouraging young students to build imagination, creativity and future problem-solving abilities, this thesis objective is to train students setting up capability for creativity information system development interesting and effectively, providing up-and-coming topics discussion, using projects, research and development results, etc. participating in practical experiences at the same time, helping students to induce motivation in learning, hoping they can learn independently after school bedsides information systems course at school.

This thesis objective is to promote and extend benefits of software design course through enhancing theories and method of Creativity education, trigger students to creative thinking then experimenting, to lead interest in learning. In this thesis, by combining Future Problem Solving (FPS), enhancing students to learn, understand system developing structure and its origins by observing, using information system what they can see or use around, explaining basic system development structure, shaping the programming course into an interesting experiment operation, changing the teaching method that we use specific program structure in

the past, accumulation learning through different permutations of programs, understand what required skills need to learn step by step, combining the plans of the course, using different topics to lead students to unleash their creativity through class , training students creativity and innovative thinking ability in programming,

In the survey US News published The 100 Best Jobs of 2014, software engineers have 70,000 vacancies in the US market employment vacancies ratio and it has almost double amount than Accounting and Auditing that has 37,000 vacancies. In England even elevated coding education rank into national level, starting to build up their talent pool for coding. (UK Government Backs Year of Code Campaign, Boosts Funds to Teach Code in Schools)We can see that, Software development technology has become an index of innovative services in industrial development as center.

Current universities and colleges in Taiwan mostly have Information and Communication Technology type departments, except in curriculum design, on how Program development courses meet the needs of talents in existing enterprise, training students to assist the industry solve emerging technological capabilities, and to reduce the student sense of exclusion in software program development and design, in this thesis, by single out the course design, research on students learning assessment target, future problem solving issues and creative teaching collaboration, extend apply to training courses from the University, to help improve student learning information software programming bottlenecks and obstacles, and future research will promote the achievement of this promotion to school Information courses from the culture fun learning, and hands-on experiments for interested ability.

Currently the US government and nongovernmental agreed that to bring up the interest early is very important (see Figure 1.), that is why industries start to develop tools that can trigger dynamic learning, not only the rapid development of learning to write programming

resources on the web like Codecademy, inventor, etc. they even put programming concept into toys (Play-I see Figure 2) making children's childhood influenced by constantly sees and hears. The US government Develop characteristics and objectives, hope to train everyone to have the ability to program instead of a professional ability, through interest, inspire innovative ideas, completing the implementation of development practices, enhancing the country's software industry competitiveness.

Figure 1. Children explains a coding learning program
to President Barack Obama during an "Hour of Code" event
(http://www.wired.com/2014/12/obama-becomes-first-president-write-computer-program, July 29, 2015)

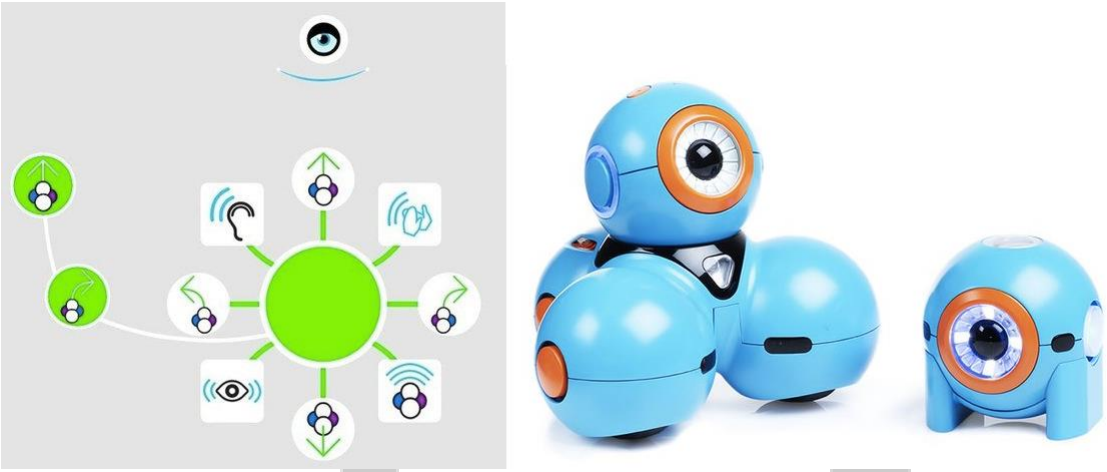

Figure 2. Play-I and its Graphical command for children to learn easy programming. (https://www.play-i.com/, July 29, 2015)

1.2 Research Motivation

Programming is a complex work, many students often encounter many problems and obstacles in training courses on their learning process, including different programming language design, mathematical logic problems, database access, and network communication barrier issue, Therefore, in the learning process, often because of different issues involving many cognitive skills and related factors [1].

Programming teaching objective is to make students solve problems according to grammar, language structure and programming language design skills [2][3], the ability to further enhance students' thinking and logic programming. According to Ssu-Lang Lin's (2004) research, programming language courses in Information Technology programs enrollment into Department of Information Management or related courses listed advanced programming language courses, so if strengthen students' logical thinking in programming language courses , enhance problem solving abilities, for learning adaptation and thinking skills are quite helpful in the future[4].

Traditional teaching objective for computer programming language is to train students

understand the basic structure of the programming language and combining the languages that learned to do problem solving and solve existing development issues. According to studies, students usually sense of exclusion in programming, even stop learning, the main reason includes:

1. Students learned programming languages structures and details, but cannot transform the knowledge into a specific problem solution so that even if the task was easy students still encounter difficulty, causing frustration when learning.
2. Details of a programming language syntax easily making students tired and bored. For students that are still in career development for the future will be feeling depressed in an incorrect way, and less likely to arouse students' motivation.
3. Different syntax has its own particularity, choosing the proper language for students that are getting started are hard to select a fitting learning method, wherefore teachers that teach syntaxes in different courses are hard to integrate and let students apply into daily use.

Through these years, the term of MOOCs (Massive Open Online Courses) has been into a populated topic in teaching, some people think that MOOCs is only watching teaching videos at home and not all the teachers have the time to make a good teaching video, having these videos, do we still need teachers?

The truth is MOOCs real objective was to use classroom hours for deeper learning activities – because transforming information (lecture) is only the lowest level in the learning activity and hoping students transform from passive information consumer to active learners.

Table 1. SWOT of learning programming in Taiwan

Strength	Opportunities
1. Currently Taiwan students have high interest in learning Innovative technology. 2. Open platform of resources facilitate student inquiry and viewing. 3. Universities have programming-related courses. 4. Programming is the base for the new generation of innovative and creative R & D infrastructure.	1. Curriculum planning amendment application modules and assessment mechanisms to enhance students' learning indicators verification through this thesis. 2. Enhance domestic IT department base capacity-building after graduation into the information industry
Weakness	**Threat**
1. Existing course cannot arouse students' interest in learning. 2. Students do not have the enthusiastic participation of interest in the practical exercise course. 3. Cases in the Course exercises cannot be combined with practical application, reduce operational studies of interest.	1. Traditional modular curriculum cannot continue to provide to meet the existing companies to develop applications 2. Students setback to learn program development causing lower interest of active Learning 3. Foreign students actively participate in creativity training programs, domestic students recession in the international market competitiveness

At Peter Pappas (http://www.peterpappas.com/, July 29, 2015) gave an advice and explain for MOOCs:

MOOCs is not a new idea, it is not trying to replace teachers and not replacing homework by watching videos, but to make the classroom hours more prolificacy, and redefining the roles of teacher and students, MOOCs is not only watching videos, but to let students inquiry independently and collaboration, building up peer instruction(peer learning basic theory can be seen on: “Don’t lecture me”[5]), making teachers have more time to watch students applying capability of knowledge, giving differentiation assistance to students in some circumstances. By main character in class transforms from teacher to student, but the teacher is the director behind the scenes, why

can it strengthen students independence learning in the process? Because they have more control to their learning, videos can be repeated and time controlled, means students do not have to be self-esteemed if they are slow learners and fast learners can speed up. Exchanging thoughts with peers or the teacher in classroom hours, not just sitting there quietly, but to promote itself in class, in a modern world that has developed internet, information and knowledge can be readily available, learners have the chance to explore and learning in a good use of technology.

1.3 Research Purpose

The objective of this thesis is to improve school programming courses in Taiwan, to train students set up Software Development Thinking, increase students interest in learning, using Future Problem Solving, research how to arouse students' programming and software development problem-solving abilities through course methods.

Currently, including Blockly Games that Google announced to let elementary students learning concepts of programming by playing, Attracting students to participate actively through entertainment and experimental attempts, to lead students having interest in hands-on experiments. Lampton School in Hounslow London West Alliance from England, teachers ask the students to make a mini games using spare time in a month through interacting, the students know how to make the game thorough finding a game that they liked a lot and tried to clone it from scratch.

These students used and programming language called “Scratch” developed by Massachusetts Institute of Technology (MIT), providing a set of existing programming languages, letting students assemble and combine their own games and videos. This programming language objective is to let students get used to programming languages, and the end by making a program themselves

From the case of Lampton School, we can analyze and understand, students learning the

basic concepts of program development needs to be taught by courses, proving students first learn and understand how to operate and simple experiments then teacher initiate sparks of ideas, to give students a perform platform to participate in the experiment, to use of existing data on hand like YouTube，wiki and other related resources integration platform, students can develop their own self-interest and imagination of the platform application, teachers help students solve development and learning the obstacles that will encounter through guiding in courses, and encourage students to participate in research, hands-on implementations, and help find use those resources to help learning.

Traditional program curriculum strategies Compare to this thesis creative teaching Structure:

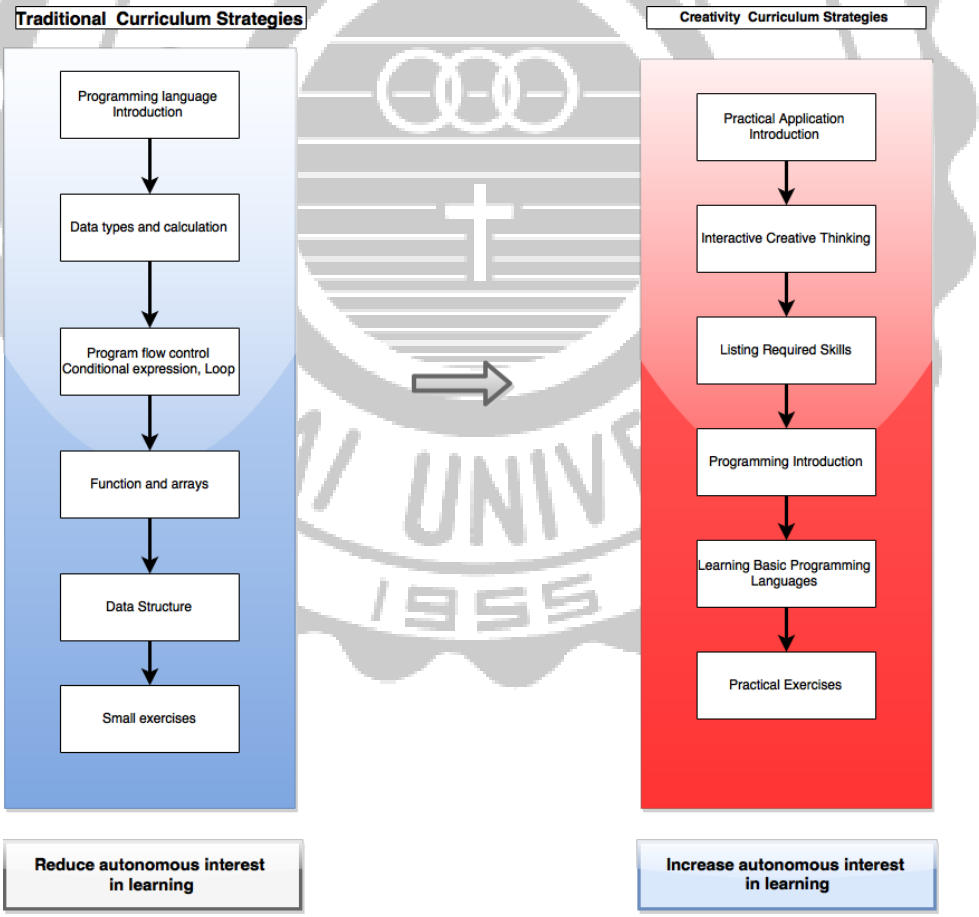

Figure 3. The promotion of creative teaching guide student's future problem-solving method pattern design

In this thesis aiming to software personnel training vision, in the current rapid growth development of digital technology we hope to build students using digital logic training, training basic programming language skills and communication with computers native language while the use of the concept of integration of technology and services contain puzzling, combination, operation, application, etc., train students interested in the technology application patterns, discover new technology integration requirements, gather information, build problem-solving skills on their own, to meet the Enterprise target of software-talented person for services requirement innovations.

1.4 Chapter Organization

The paper chapter's arrangements are as follows:

Chapter 2: Literature Reviews of school informational technology course, Creativity in Information technology and Creativity problem solving.

Chapter 3: The papers objective Curriculum Architecture and Course Design.

Chapter 4: Case Studies between our course and traditional courses.

Chapter 5: Conclusions and Future Works of the paper.

Chapter 2. Literature Reviews

2.1 Small Private Online Course (SPOCs)

MOOC vs SPOC [6]

The 7.00x MOOC is structured as an on-line analog of an in-person class. The material is broken up into weekly units each with several lectures, supporting materials, and a problem set. The goal of these materials serve a different role: to support activities during the in class sessions. To facilitate this alternative use, Brian White [7] made several changes to the MOOC materials to produce the SPOC that he use with his students:

- **Make independent units for each class session.** Each of the 30 class sessions is supported by one lecture video with associated 'test yourself' questions and some problem set questions (now called "warm-up questions").
- **Use problems for warm-up not credit.** The goal is to have the students come to class prepared to use the material. They do not have to understand it all; the minimal goal is that they have at least thought about all of it. For that reason, the students are required to answer the problems correctly to receive credit towards their final grade, but, after their first attempt, they can see the correct answer. So, at the very least, they've entered the correct answer to each problem before coming to class.
- **Add supplementary problems.** To provide further practice for the exams.

The difference between a “MOOC unit” (one week) and a “SPOC unit” (one day) is shown in the Figure 4 below:

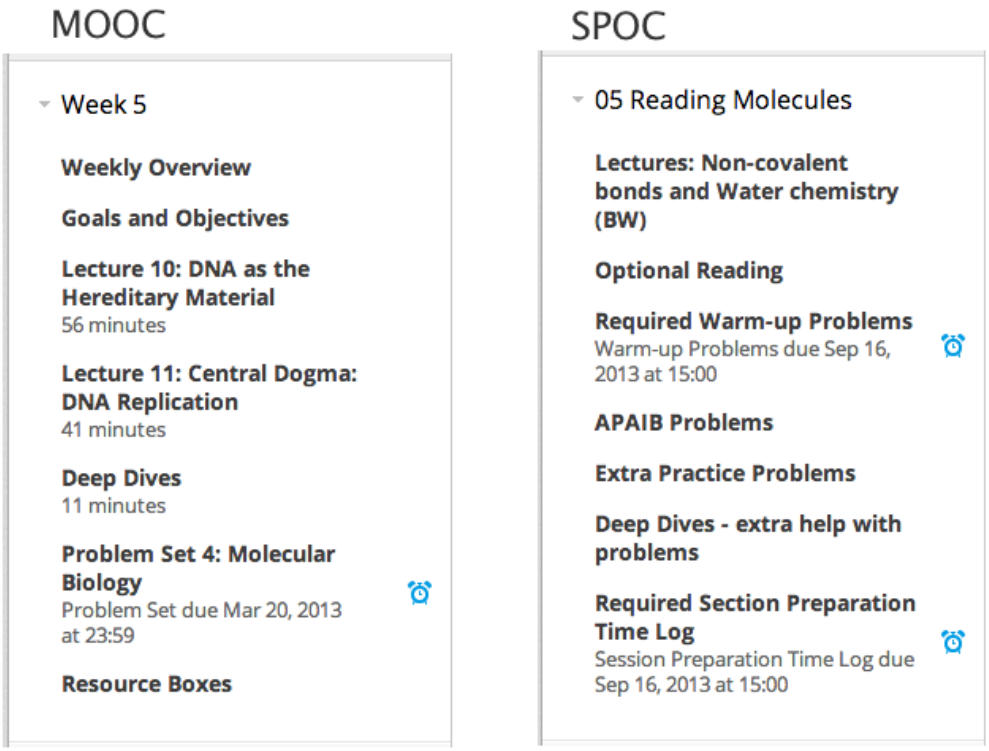

Figure 4. MOOCs vs SPOCs unit difference [7]
(https://www.edx.org/blog/edx-spoc-online-backbone-flipped-college, July 29, 2015)

2.2 Creative Problem Solving (CPS)

To Information Technology the importance of Creativity goes without saying, if a person had the creativity to create a more valuable system or software, or having new thoughts to improve systems, shorten working time or even create a whole new working method, this is a key to make an organization stay competitiveness in long-term.

How to stay creativity? In Jia-Ping You’s Research [8] has shown that Positive psychological capital makes a person thinks more because it is not susceptible to setbacks and gets stronger every time, Role identity is that having good relationship and interaction with peers in a forward attitude, helping each other out when there is a

need, these two types are the main source to be creative and makes a huge different to people that do not have both situations. But being creative is not only a person has positive thoughts or good peer interacting but learning how to Creative problem solving or other methods means much more.

Creative problem solving is a type of problem solving, is the mental process of searching for a new and novel creative solution to a problem, a solution which is novel, original and not obvious.

Creative problem solving process (Figure 5):

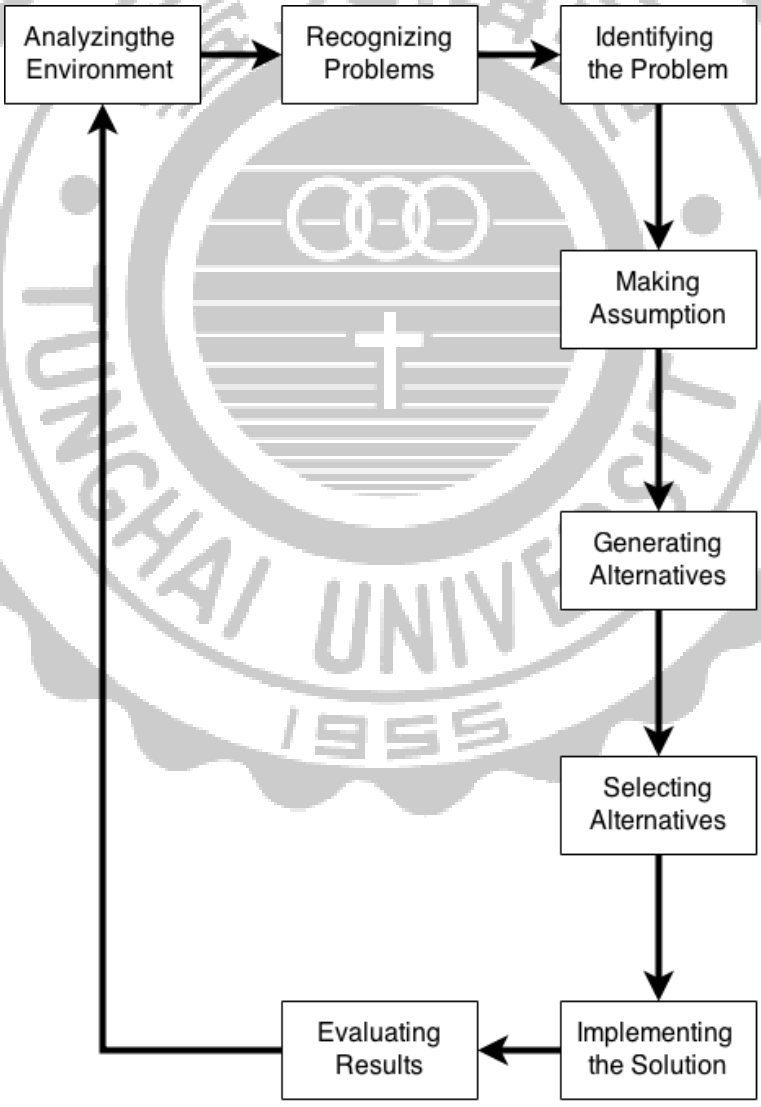

Figure 5. Creative problem solving process

In the newest version of CPS is 6.1[9] [10] four main components and eight specific stages illustrated in the Figure 6 and tabled in Table 6 below:

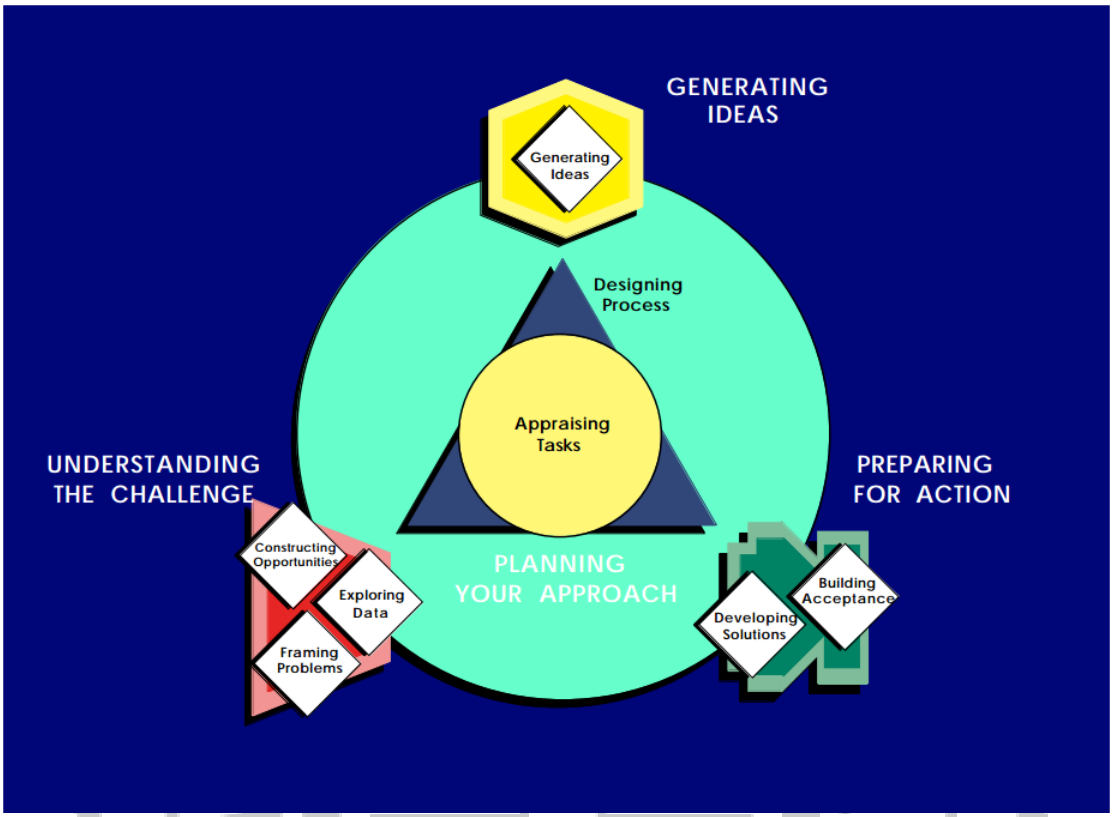

Figure 6. CPS 6.1 Framework (http://www.cpsb.com/resources/downloads/public/CPSVersion61B.pdf, July 29, 2015)

Table 2. CPS 6.1 process execution order

Component	Stage
Understanding the Challenge	Constructing Opportunities
	Exploring Data
	Framing Problems
Generating Ideas	Generating Ideas
Preparing for Action	Developing Solutions
	Building Acceptance
Planning Your Approach	Appraising Tasks
	Designing Process

A. Understanding the Challenge

Understanding the Challenge involves investigating a broad goal, opportunity, or challenge, and clarifying, formulating, or focusing your thinking to set the principal direction for your work. Use one or more of the three stages in Understanding the Challenge when you need to explore and focus your thinking about your goals, objectives, or directions you hope to pursue.

Stage 1. Constructing Opportunities: Stating broad, brief, and beneficial opportunities and goals. Considering possible opportunities and challenges, and identifying a constructive goal to pursue.

Stage 2. Exploring Data: Examining many sources of data from different points of view, and focusing on the most important elements of the task or situation. Considering what you know about the situation and what you need or want to know, to get to the "heart "of the matter.

Stage 3. Framing Problems: Generating many, varied, and unusual ways to pose the problem, and then focusing on a specific statement that will "open the door" for and invite creative ideas. It helps you to think about, "how might we" rather than "we can't because"

B. Generating Ideas:

Generating Ideas, which has one stage, involves coming up with many new possibilities. Generating Ideas is viewed by many people as "creative," and is sometimes (in error) equated with "brainstorming." We view Generating Ideas as one important component and stage among several in CPS, and we use brainstorming as one specific tool (among many) for generating options.

Stage 4. Generating Ideas.: An open, exploration or search for ideas, in which you generate many ideas (fluency in thinking), varied ideas and new perspectives (flexibility), and unusual or novel ideas (originality), and then focus your thinking

by identifying ideas with interesting or exciting potential to refine, develop, and put to use.

C. Preparing for Action

Preparing for Action involves exploring ways to make promising options into workable solutions and preparing for successful implementation. It helps you to take promising solutions and develop them so they're as strong as you can possibly make them, and to consider ways to create the best possible chance of success.

Stage 5. Developing Solutions: Applying deliberate strategies and tools to analyze, develop, and refine promising possibilities, and to transform them into promising solutions.

Stage 6. Building Acceptance: Considering ways to build support and to decrease or overcome resistance to possible solutions, and planning specific ways to carry out and evaluate your results and effectiveness.

D. Planning Your Approach

Planning Your Approach involves keeping track of your thinking while it is happening, to insure that you're moving in the direction you want to go. It also guides you in "customizing" or personalizing your approach to applying CPS.

Stage 7. Appraising Tasks: Determining whether CPS is a promising choice for dealing with a particular task, and taking stock of the commitments, constraints, and conditions you must consider to apply CPS effectively (the people involved, the results you desire, the context in which you are working, and the methods available).

Stage 8. Designing Process: Using your knowledge of the task and your needs to plan the CPS components, stages, or tools that will be best-suited to help you reach your goals.

2.4 Computational Thinking:

Creative thinking involves core cognitive competencies of capturing novelty, challenging established thinking and behavior patterns, broadening one's knowledge beyond one's discipline, and surrounding oneself with new social and environmental stimuli, but Computational thinking [13][14][15] involves conceptualizing at multiple levels of abstraction, defining and clarifying a problem by breaking it down into relational components, and testing and retesting of plausible solutions.

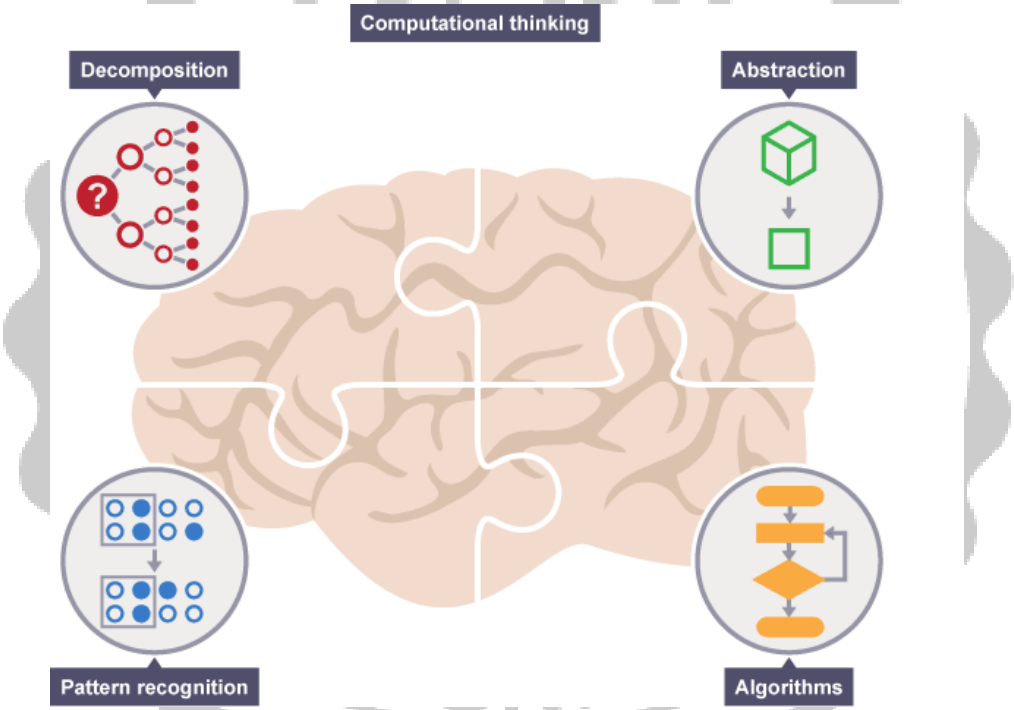

Figure 7. Four steps of Computational Thinking
(http://www.bbc.co.uk/education/guides/zp92mp3/revision, July 29, 2015) [16]

There are four core abilities to learn:

Decomposition: Breaking a task or problem into steps or parts.

Example:

- When we taste an unfamiliar food and identify several ingredients based on the flavor, we are decomposing that dish into its individual ingredients.

- In mathematics, we can decompose a number such as 248.65 as follows: $2*10^2+4*10^1+8*10^0+6*10^{-1}+5*10^{-2}$
- In science we decompose a projectile's velocity into its components in the x and y direction.

Pattern Recognition: Make predictions and models to test.

Example:

1. People look for patterns in stock prices to decide when to buy and sell.
2. In mathematics, when calculating the largest area possible for a rectangle of a given perimeter, we can see patterns in the length, width, and area such as:
   - As the length and width approach each other in value, the area increases
   - As the difference between the length and width increases, the area decreases
3. In science we see patterns in the periodic table that describe the common properties between elements.

Pattern Generalization and Abstraction: Discover the laws, or principles that cause these patterns.

Example:

1. A daily planner uses abstraction to represent a week in terms of days and hours, helping us to organize our time.
2. In mathematics, we write generalized formulas in terms of variables instead of numbers so that we can use them to solve problems involving different values

- The slope of any straight line can be described as a function of $y = mx + b$

3. In science, we use theories to describe the generalized mechanism by which natural phenomena occur.

Algorithm Design: Develop the instructions to solve similar problems and repeat the process.

Examples:

1. When a chef writes a recipe for a dish, she is creating an algorithm that others can follow to replicate the dish.
2. In mathematics, when we add and subtract fractions with different denominators, we follow an algorithm.
3. In science, algorithms enable us to model the world around us using tools like CAD, and programming languages like Python. These models can be used to predict future events like a solar eclipse.

Practical Exercises: After learning the basic coding languages, the teacher will give a subject, situation or problem for students to practice coding skills, by learning problem solving skills from the main course, students can group up and brain storm with each other, leading more creativity solutions for solving the situation.

Chapter 3. Curriculum Architecture and Course Design Method

3.1 Curriculum Architecture

The Curriculum structure is shown in Figure 7 below, first we use a Marco scenario to bring students into the course, then the major parts can be split into two, the CPS course and the programming course, as for the main course main objective is learn to be creative and the programming course is learning and enhancing skills of programming, the CPS course and programming course can be applied to each other, creating a cycle bringing creativity and programming together, and learning after the two courses, the students can use their programming skills for competition for Olympiad in informatics , computer and even more uses ready for other future needs.

3.1.1 Marco Scenario

Marco scenario [11] is the first step in the full course, telling a story, creating a situation, then design a caring product. In traditional systemization design patterns, mostly is designer's point of view, making functional designs by exploring relationship between objects, but forgetting designers and users have different cognitive seeing or using the product. Scenario is when developing a product, by imagining a story, including user's relationship to feature, events, products and environment, simulating the situation use of the product in the future, discussing and analyzing the interaction between people and the product, continuing visualize and experience to guide the people who design and develop, by using users angle to explore product ideas,

analyzing whether it fits the design thesis meanwhile testing the product idea fits the users potential needs, as we call it ”User-centered” designing.(see Figure 8)

The Marco Scenario here is describing the interaction, people, things, time and places between the product and the expected user and linking it into a whole story, leading students having interest in Programming.

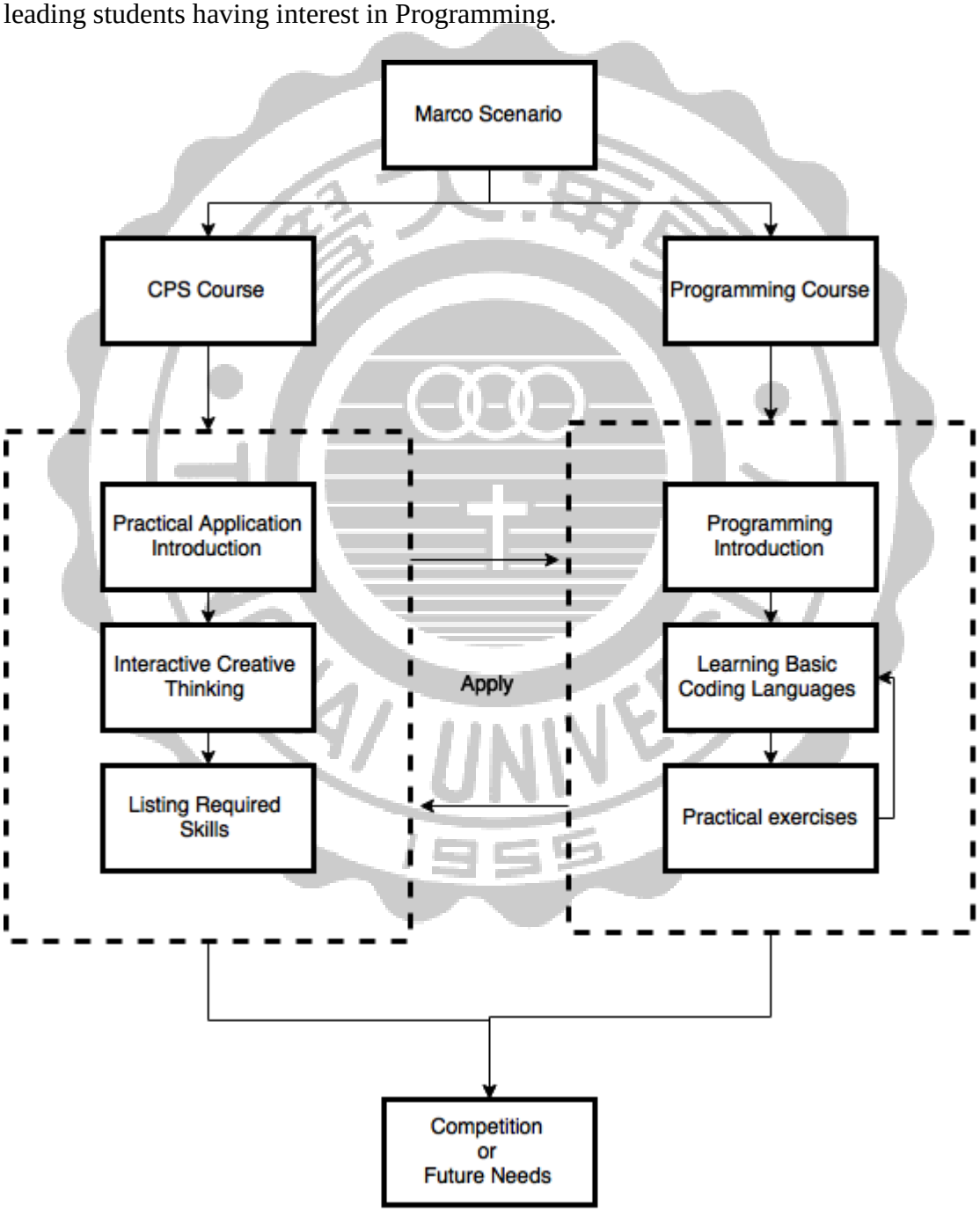

Figure 8. Curriculum structure of the whole thesis

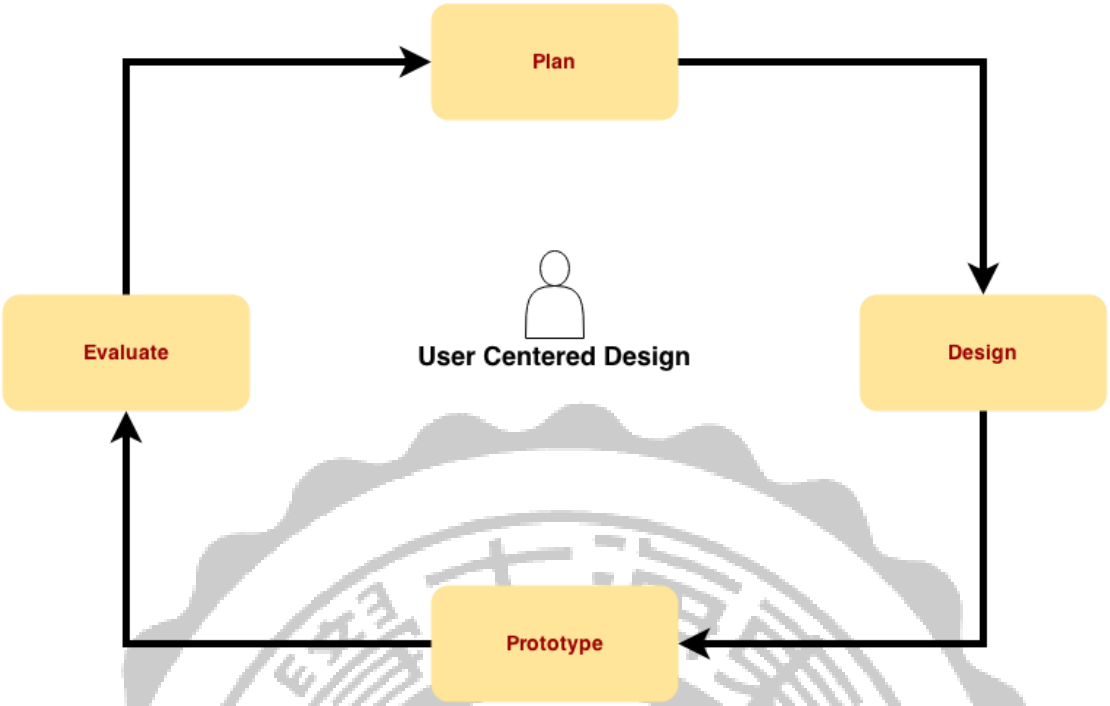

Figure 9. User-centered designing

3.1.2 CPS Course Design

In the CPS course will be divided into 3 steps, Practical Application Introduction, Interactive Creative Thinking and Listing Required Skills (see Figure 9), the course main objective is to help students interact with peer and share thoughts with each other, as we called a “Flipped Classroom”, teachers stand out and provided new information when student discuss and needs professional advice , changing and thinking ideas with each other in a positive attitude, and applying techniques from the programming course, students can consider more specific ideas and skills in the CPS course.

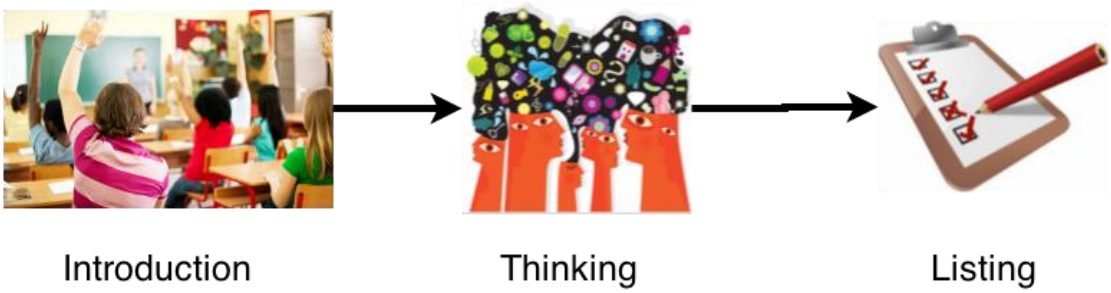

Figure 10. CPS course process

Practical Application Introduction: There are lots of System Application that are made successful everywhere, the course will be discussing why are they successful in different angles and then having students talk over each other according to their thoughts.

Interactive Creative Thinking: After talking about practical applications, the teacher will give a subject, situation or problem, leading students in group to think and understand the cause, thinking through and generating ideas using Attribute Listing(Figure 10) and Six Thinking Hats (Figure 11) to see the difference, at the end by Action planning the objective of the whole idea.

		
Spain	Jet-powered	Safe and Secure
Fighting	Bomber	Loving relationship
Dangerous	Fast	Warm
Powerful	Flies high	Friendly
Has horns	Used in wars	Caring
Steer	Destroys enemies	Lasting relationship
Part of food chain	Has a pilot & crew	

Figure 11. Attribute Listing

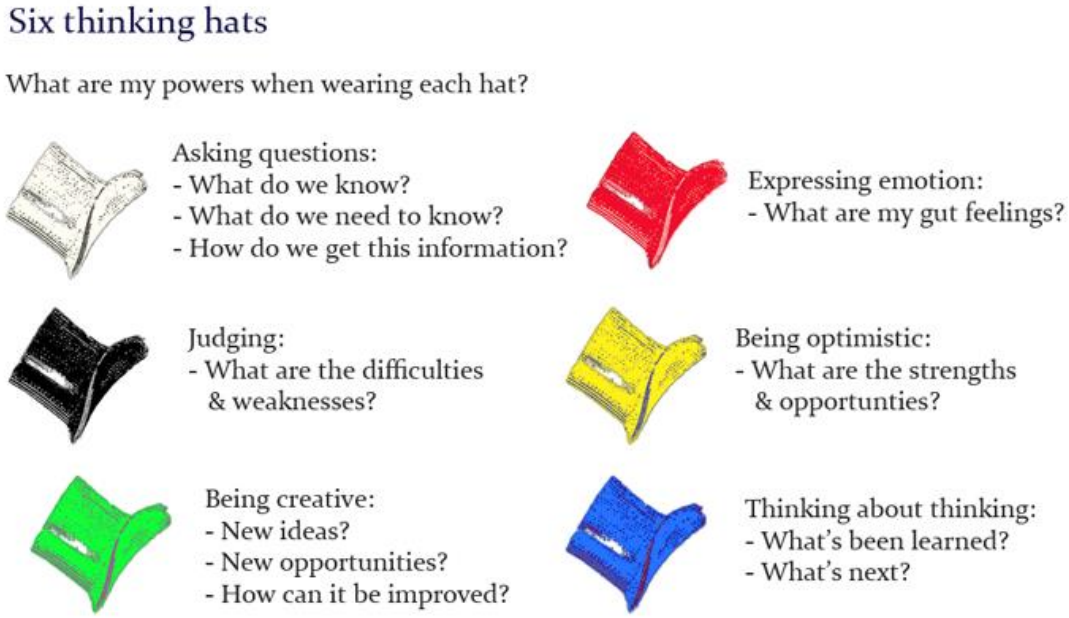

Figure 12. Six Thinking Hats (http://www.crowe-associates.co.uk/coaching-and-mentoring-skills/six-thinking-hats-coaching-tool/, July 29, 2015)

Listing Required Skills: At the end of figuring the whole idea out, students have to find which skills they need to require, making sure that the whole design does not miss any resources that are needed or having useless resources to waste.

3.1.3 Programming Course Design

In the Programming course will be divided into 3 steps, Programming Introduction, Learning Basic Coding Languages and Practical exercises (see Figure 12). The programming course main objective is helping students improving their programming skills using Creative problem solving at the same time, by numerous of practicing can improve less failing and frustration, even failing again, by applying techniques from the CPS course, we can think and create more coding solution for the requirement. Learning Basic Coding Languages and Practical exercises is a cycle, letting students learn other useful languages for other situations if the original use language cannot handle.

Figure 13. Programming course process

Programming Introduction: When learning how to program, we have to know what is programming, by starting with some activities like Graph Paper Programming [12] (see Figure 13) to let students understand the difficulty of translating real problems into programs, learn that ideas may feel clear and yet still be misinterpreted by a computer and practice communicating ideas through codes and symbols. There are websites like code.org provides games like flappy bird that can be easily customized by simple coding with Blockly (see Figure 14), leading students to learn algorithm in an interesting way.

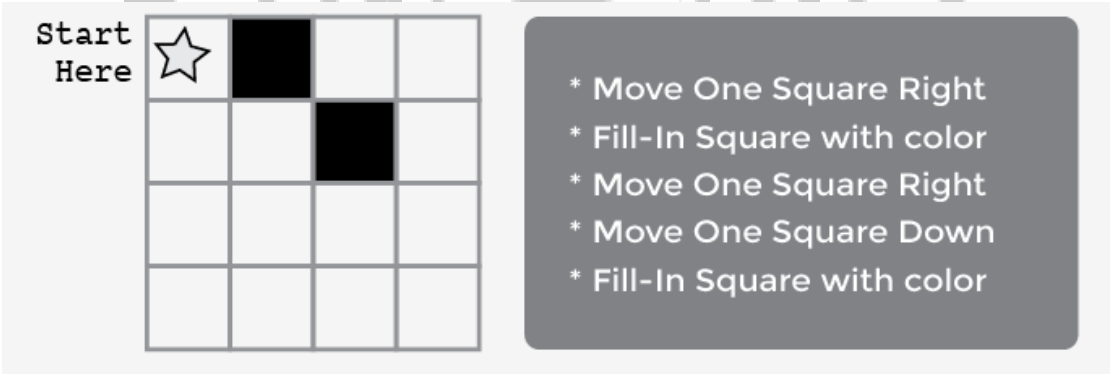

Figure 14. Graph paper programming (http://code.org/, July 29, 2015)

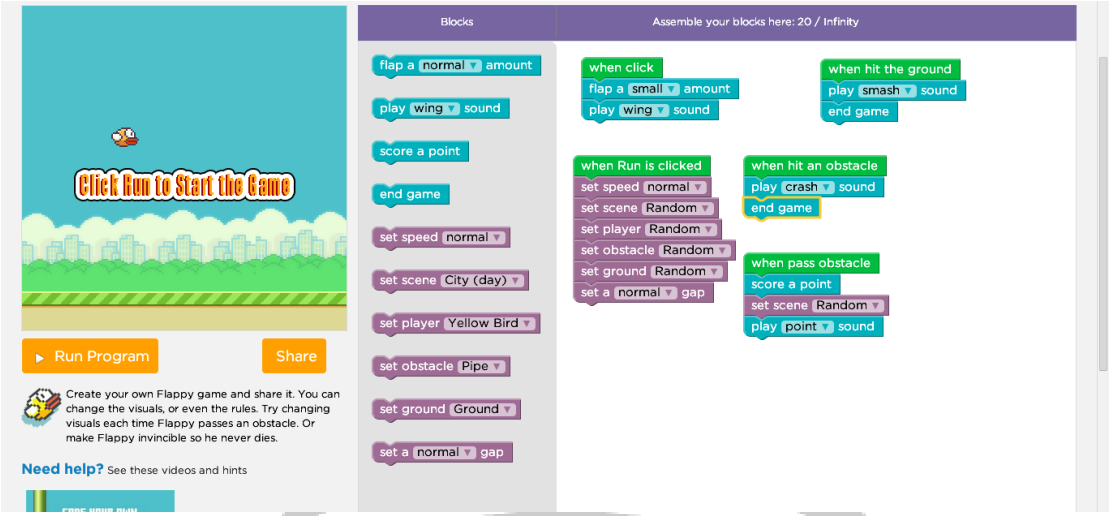

Figure 15. Flappy bird blocky coding (http://code.org/, July 29, 2015)

Learning Basic Coding Languages: After the introduction, it is time to introduce some basic coding languages and tools. Though there are Traditional text-type coding (see Figure 15), if the student doesn't have any experience in coding, they will get frustrated very quick and loses interest in coding, we suggest to use Blockly coding languages at first like python (see Figure 16) or APP Inventor 2(see Figure 17), not only learning programming from graphic to text will be much easier to train logic, even most programming is based in English, students in Taiwan with no English proficiency can start learning programming in Chinese (see Figure 18) with Blockly, and can train English side by side looking at the text code.

Computational Thinking:

By writing programs (making a game as sample), you might occur complex problems, by using computational thinking, students can try to solve:

- Each complex problem was broken down into several small decisions and steps (eg where to go, how to complete the level – **decomposition**)
- Only the relevant details were focused on (eg weather, location of exit – **abstraction**)
- Knowledge of previous similar problems was used (**pattern recognition**...
- ...To work out a step by step plan of action (**algorithms**)

```c
#include <windows.h>

/* This is where all the input to the window goes to */
LRESULT CALLBACK WndProc(HWND hwnd, UINT Message, WPARAM wParam, LPARAM lParam) {
    switch(Message) {

        /* trap the WM_CLOSE (clicking X) message, and actually tell the window to close */
        case WM_CLOSE: {
            DestroyWindow(hwnd);
            break;
        }

        /* Upon destruction, tell the main thread to stop */
        case WM_DESTROY: {
            PostQuitMessage(0);
            break;
        }

        /* All other messages (a lot of them) are processed using default procedures */
        default:
            return DefWindowProc(hwnd, Message, wParam, lParam);
    }
    return 0;
}

/* The 'main' function of Win32 GUI programs: this is where execution starts */
int WINAPI WinMain(HINSTANCE hInstance, HINSTANCE hPrevInstance, LPSTR lpCmdLine, int nCmdShow) {
    WNDCLASSEX wc; /* A properties struct of our window */
    HWND hwnd; /* A 'HANDLE', hence the H, or a pointer to our window */
    MSG Msg; /* A temporary location for all messages */

    /* zero out the struct and set the stuff we want to modify */
    memset(&wc,0,sizeof(wc));
```

Figure 16. Traditional coding

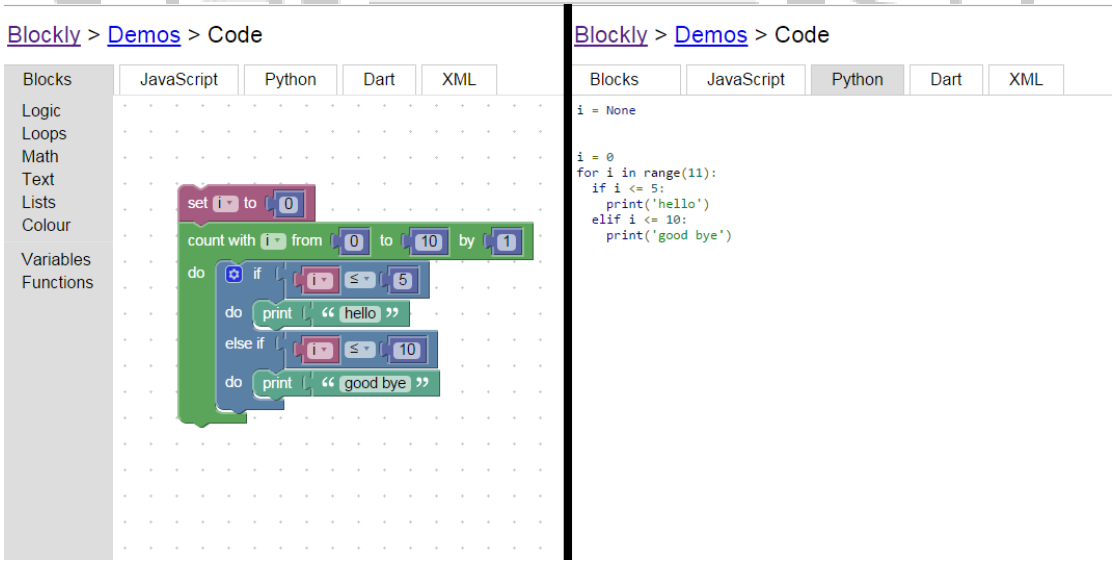

Figure 17. Python using Blockly and converting into text

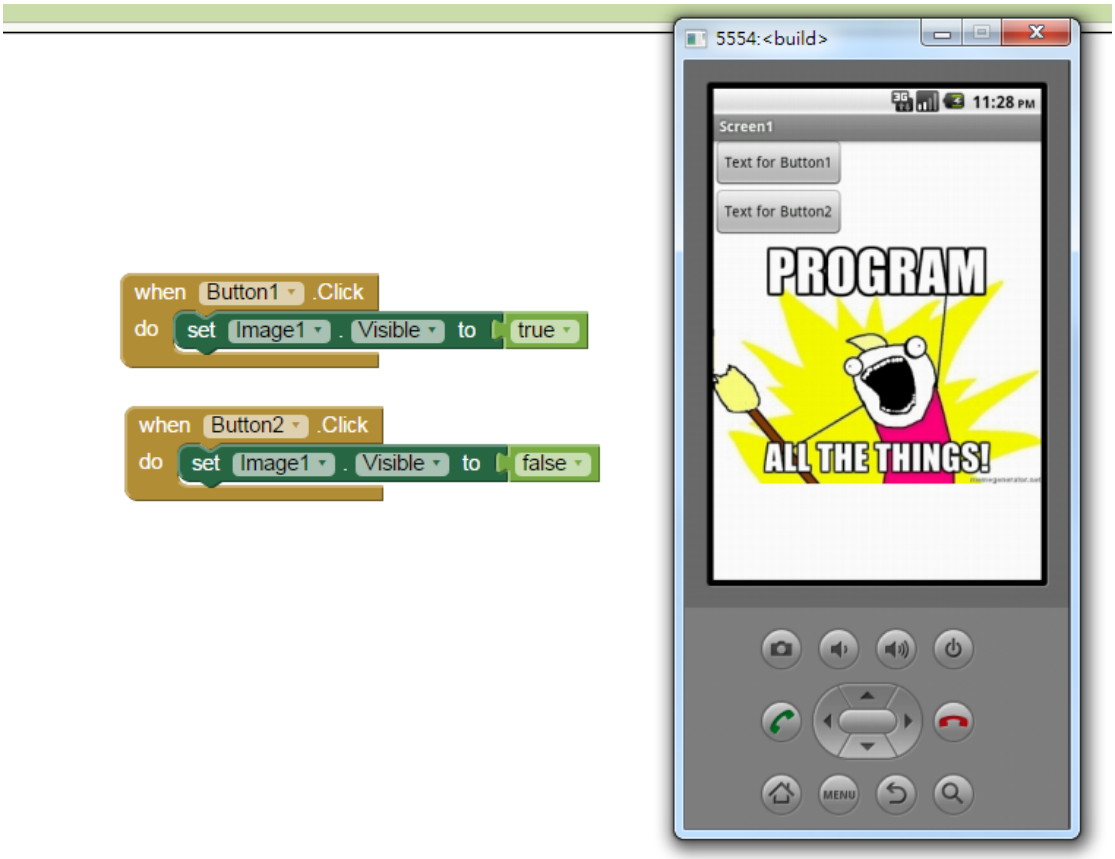

Figure 18. App Inventor 2 using Blockly to write android applications

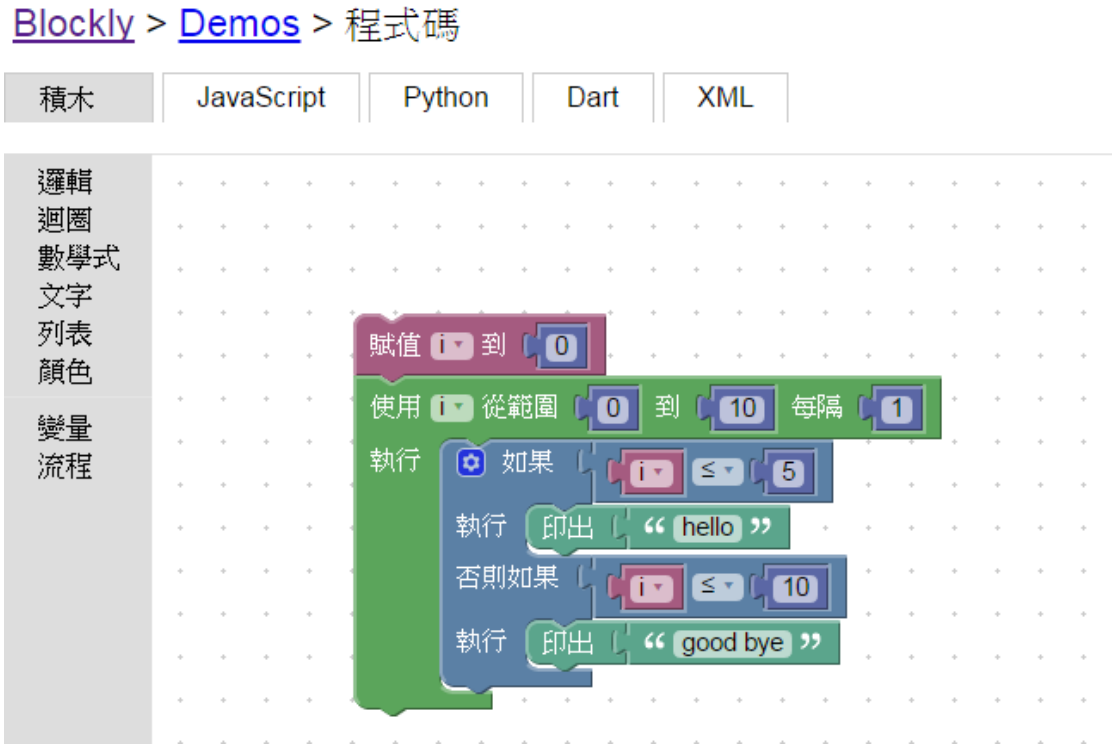

Figure 19. Using Chinese to learn python

3.1.4 Competition and Future Needs

When all the Course is done, we will see if there are students that have interest in competitions like Olympiad in informatics, hackathon, International Bebras Contest…etc. Other than competitions, we'll let students try basic projects on their own, see if they can use their creativity and programming skills to develop new Applications and help students ensure they have the availability.

Chapter 4. Curriculum test and Case Studies

4.1 Sample Course Online Platform

To ensure the course ware and method can be fully tested, we first build up a SPOC(Small Private Online Course) website (see Figure 19), as we can see there are two courses one is for the CPS course(see Figure 20) and one for the programming course(see Figure 21). We told the students to watch the courses to prepare the knowledge a week before the class. The main class week twelve topic is mobile apps, we will be talking successful app on mobile platforms and the programming class is talking about making a clone of a success mobile app by using programming tools.

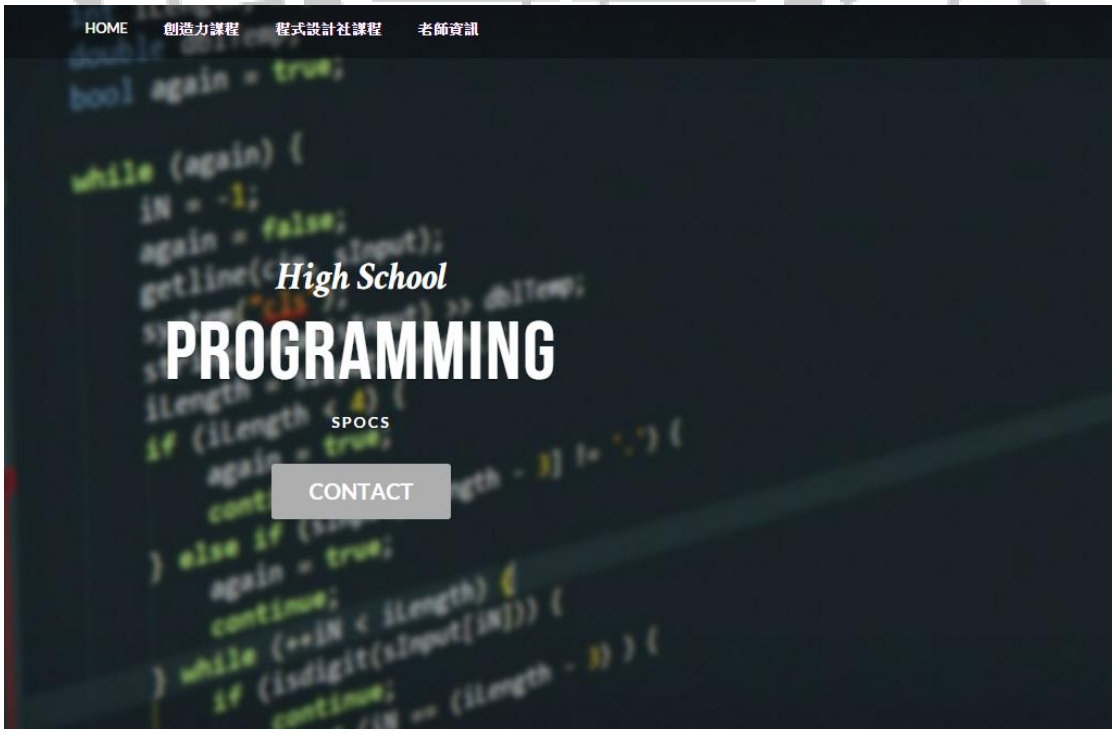

Figure 20. SPOCs course website

Figure 21. CPS course

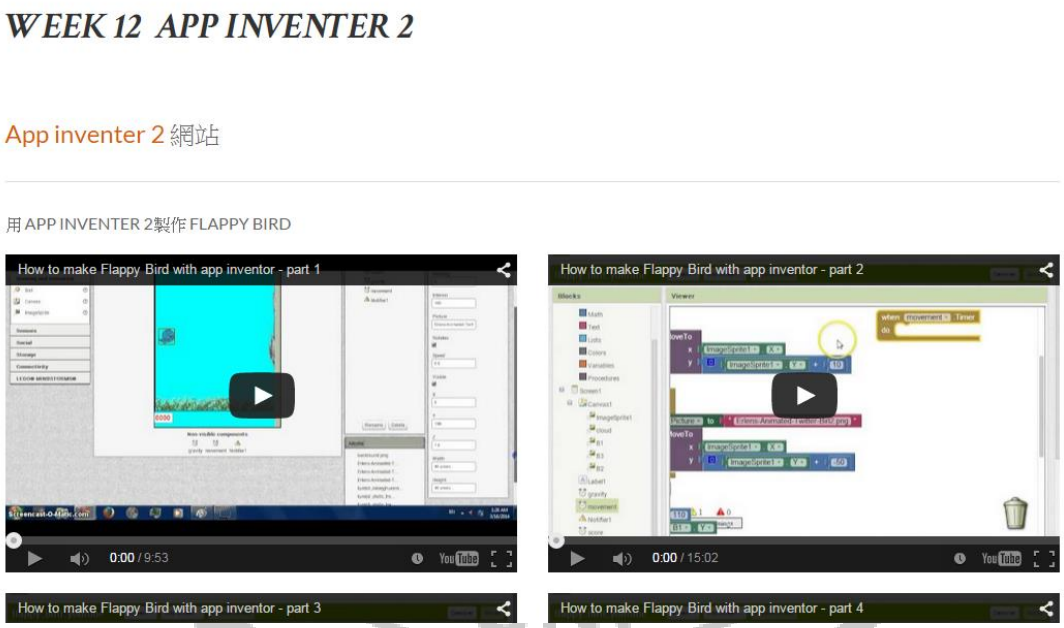

Figure 22. Programming course

4.2 Sample Class Hours Implement

As we had the students to prepare for the class on SPOCs website, on the first testing week we asked them why flappy bird and other apps on the store are so successful, what did they have in common? After hearing some answers, we told them to discuss in groups if they had the skills to write an app instantly, what would they want to write? Why do they want to write it? What challenges will they experience

and how to solve it? When the discussion is done, they have to come to the front and talk about their apps details, the audience needs to ask questions about problems of the app or giving advices.

The second testing week on the programming course is to test out the apps we tested out all the custom flappy bird apps(see Figure 22) they wrote at home and discussed what problems they experienced, instead of us telling what problems they had, we ask students to use computational thinking – Decomposition, by splitting the steps, the problems answer can be found quickly, other students can \ help answering which part of other students program had problems, or giving some advice, after debugging all the students apps, we let students to play other students customized flappy bird and to have an easy completion on which flappy bird is more creative.

Figure 23. Custom flappy bird clones (http://qooah.com/2014/03/06/60-flappy-bird-clones-hit-itunes-app-store-every-day/, July 29, 2015)

4.3 Paper Questionnaire

Before and after the testing course, we made a survey to let the students to fill out

(see Figure 23), the survey main objective is to know how students think they are creative enough and know how to solve problems between Traditional courses method and the course method this thesis used, this helps us analysis the result how the thesis method can be more useful and better than Traditional course method.

Questionnaire questions:

COURSE

1. Learning objectives clear
2. Learning Content use for work
3. Understand the learning Content
4. Use example, quizzes, case studies to help learning
5. Problem-solving ability
6. Use auxiliary media to enhance learning effect
7. Sufficient time to complete the learning objectives
8. Use Peripheral resources to meet the needs of learning
9. Prepared
10. Have sufficient Related knowledge
11. Class participation
12. Positive feedbacks

The survey use “Extremely good”, “Very good”, “Moderately good”, “Slightly good”, “Not at all good” as answers.

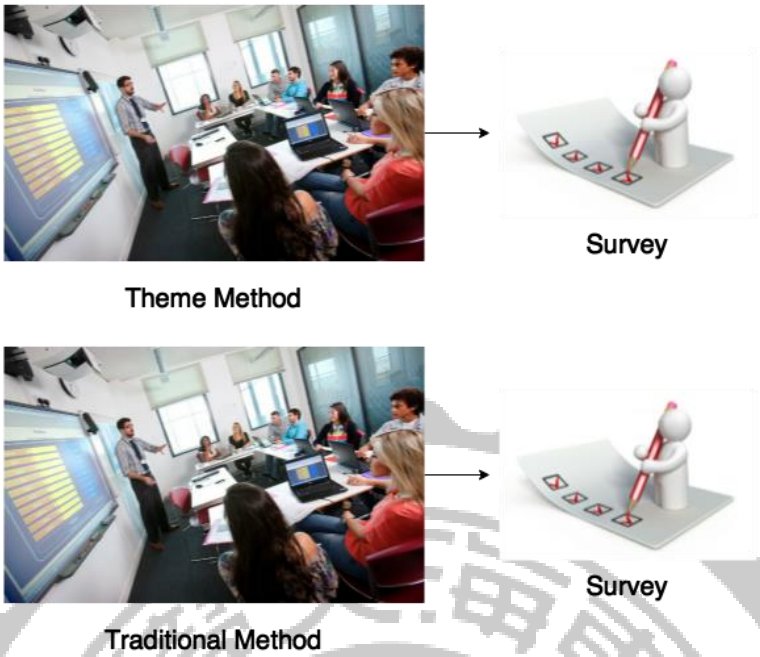

Figure 24. Survey process by using both methods

4.4 Field Testing Course Method Results

We had a testing course on a class in college to test out our Class method of Flipping Class and Creative Thinking. The Teaching plan (see Appendix I.) is to teach students to know the means of Software as a Service (SaaS) and using it. We compared with the same class by using traditional methods first and had 50 students to write the Questionnaire.

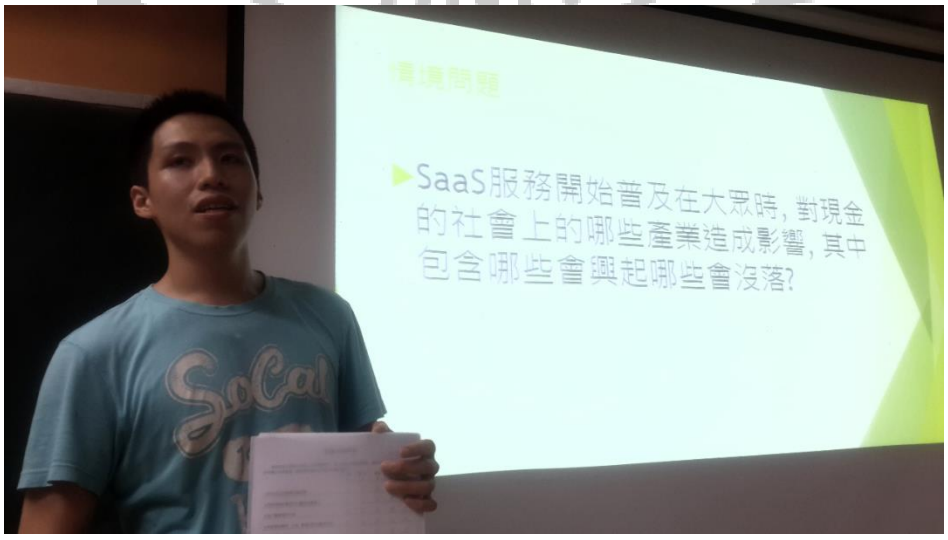

Figure 25. Asking a Situation problem and have the students discuss

Below are charts of the Questionnaire results:

In figure 26. , students in traditional method can be seen that not all people are really clear about the learning objectives, but for the theme method, students seem to be more clear about the learning objectives.

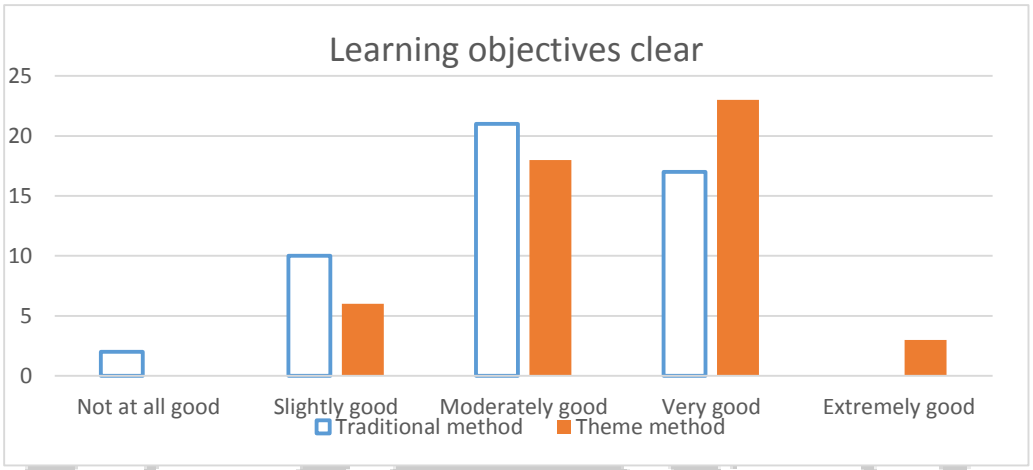

Figure 26. Students clear about their learning objectives

In figure 27. , students in traditional method can be seen that most people think that they could use the learning content for work, comparing to theme method, students know how to further use the content for work.

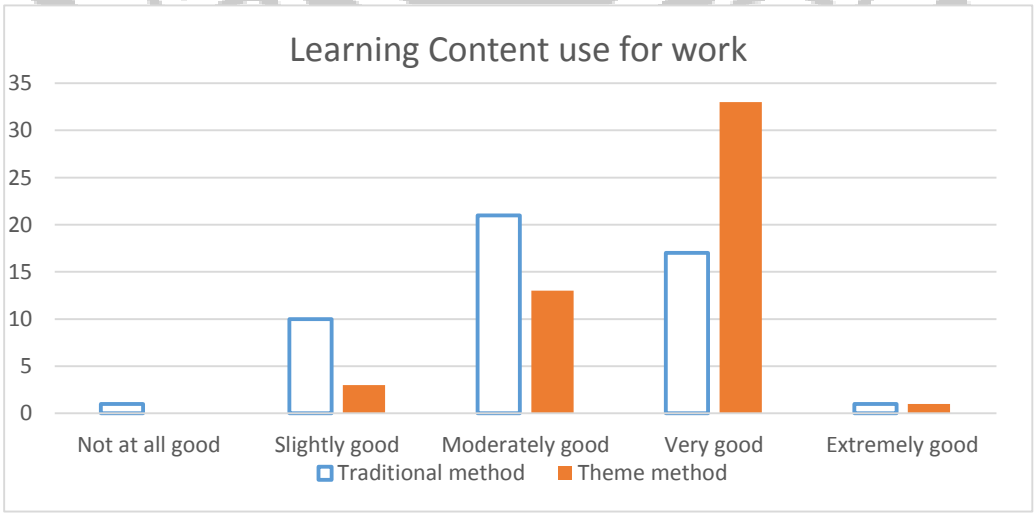

Figure 27. Students can use what they learn for work purpose

In figure 28. , students in traditional method can be seen that most people moderately understand the learning content, in the theme method, students slightly became better understanding the content.

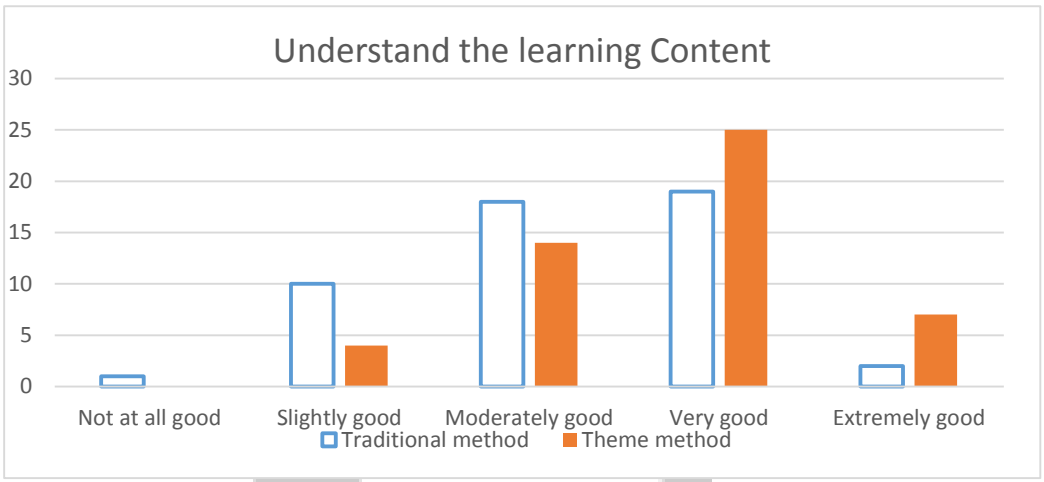

Figure 28. Students Understand about the learning content

In figure 29. , students in traditional method still can use examples to help learning, with the theme method, by using online course platform, students can get even more information to help with their learnings.

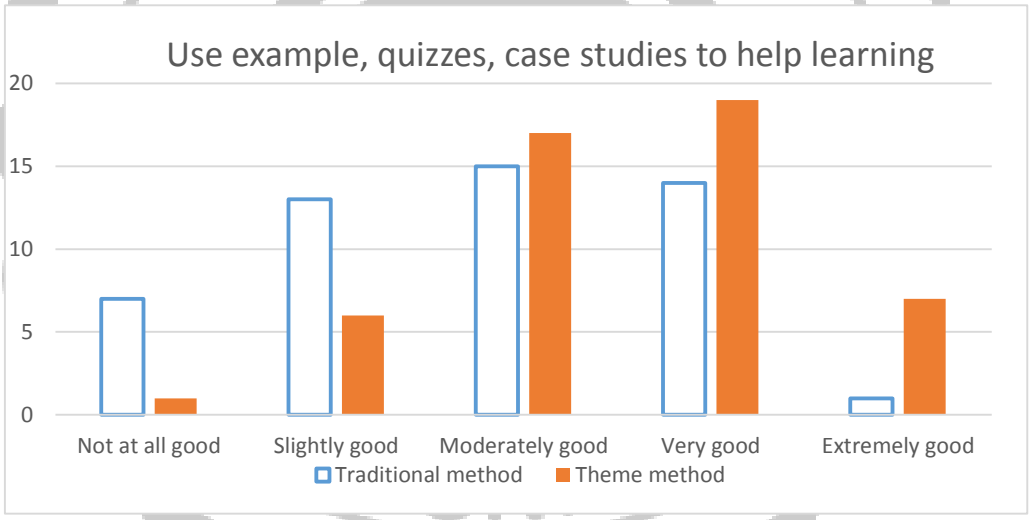

Figure 29. Students understand to use examples, quizzes and case studies to help learning

In figure 30. , students in traditional methods most student think that they don't know how or not knowing how to solve problems, using the theme method, students become more confidence and interact with peers to solve problems.

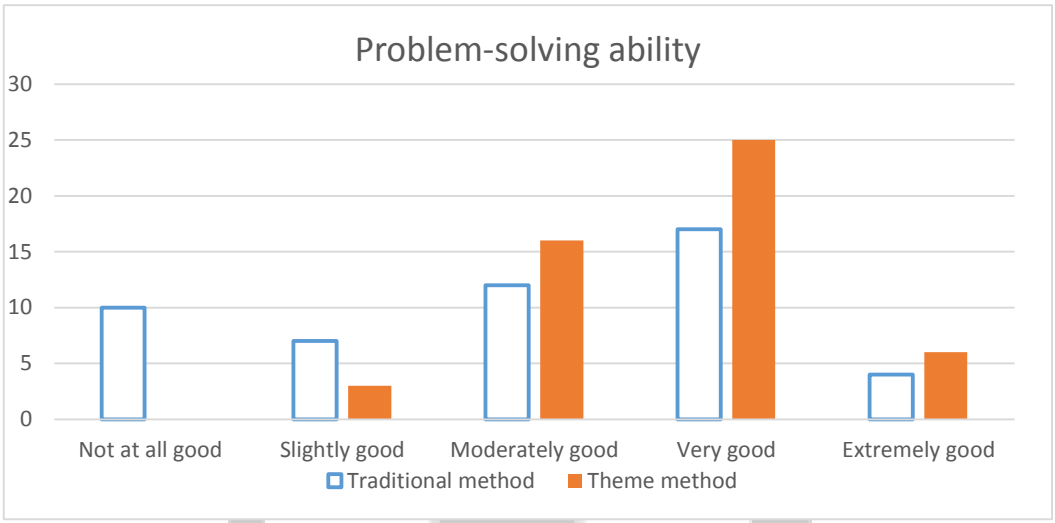

Figure 30. Students have the ability to Problem-solving

In figure 31. , students in traditional methods most student think that they don't know how or not knowing how to solve problems, using the theme method, students become more confidence and interact with peers to solve problems.

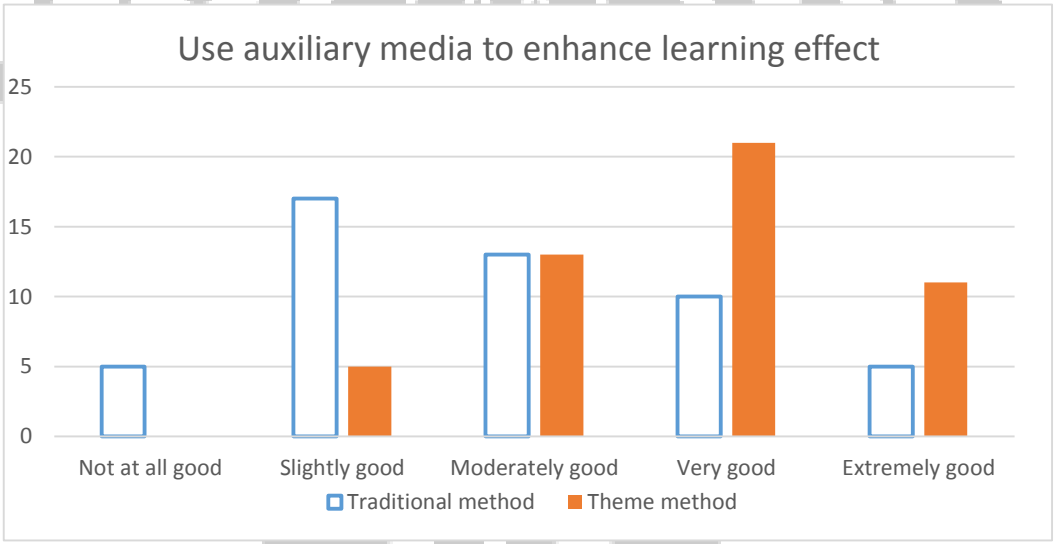

Figure 31. Students understand to use auxiliary to enhance learning effect

In figure 32. , students in traditional methods most student cannot complete the learning objectives in a sufficient time, by using the theme method, students understands more clearly and can complete the learning in time.

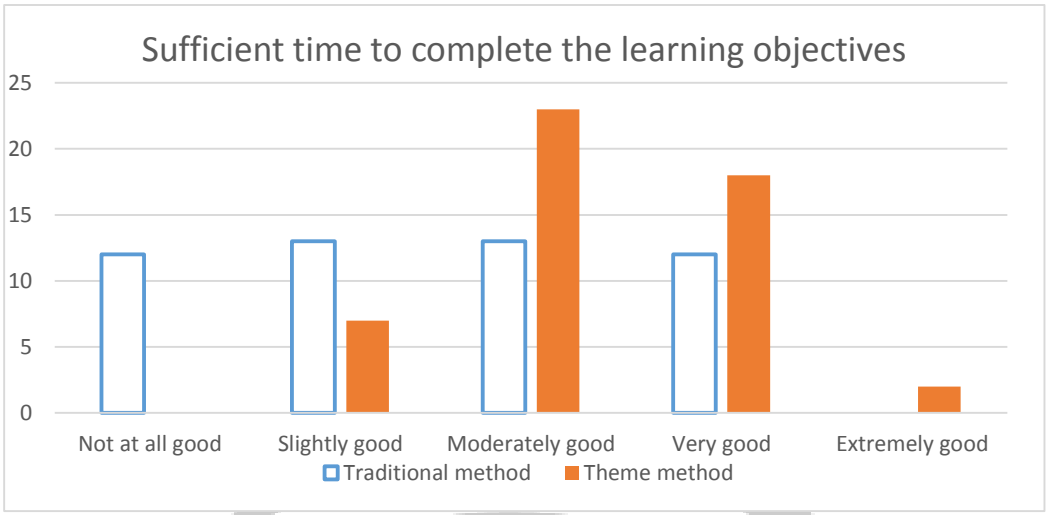

Figure 32. Students can complete learning objective in a sufficient time

In figure 33. , students in traditional methods most student already have technology to find resources, so there is no big difference with the theme method.

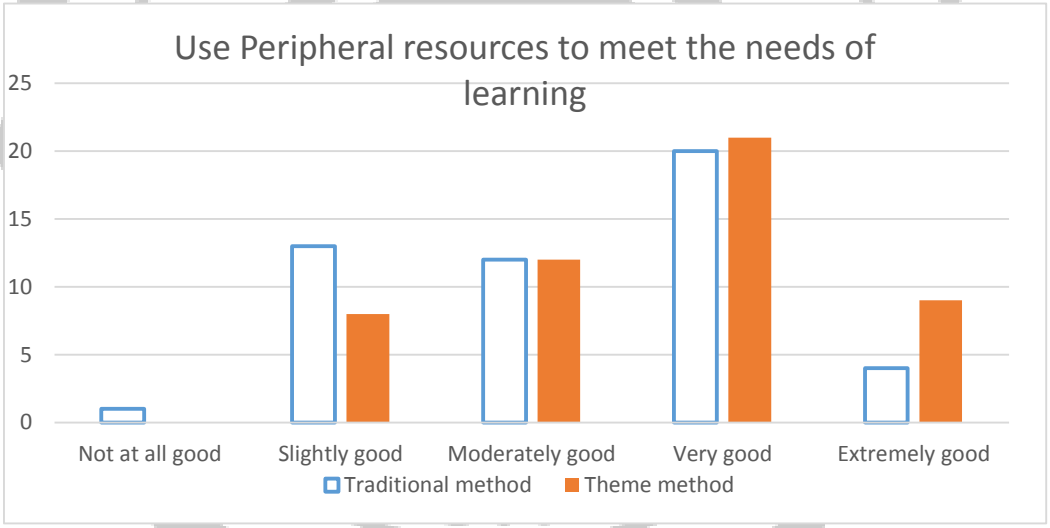

Figure 33. Students us peripheral resources to meet the needs of learning

In figure 34. , students in traditional methods were not all well prepared for the class (they even didn't buy the textbook), by using the theme method, students can learn some information before class and be prepared.

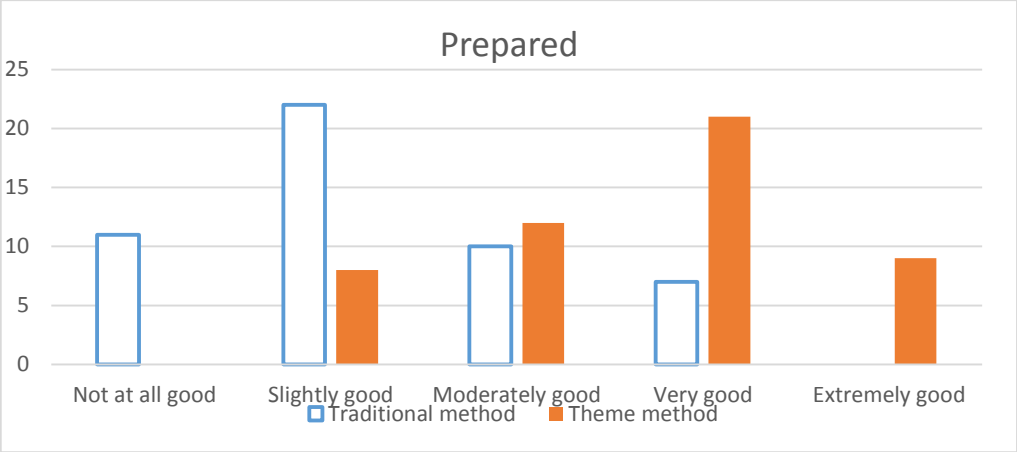

Figure 34. Students prepared for class

In figure 35. , students in traditional methods mostly do not have sufficient related knowledge due to that they don't even have textbooks, but have a online platform and learning media for the theme method, students can read easily and have related knowledge for class.

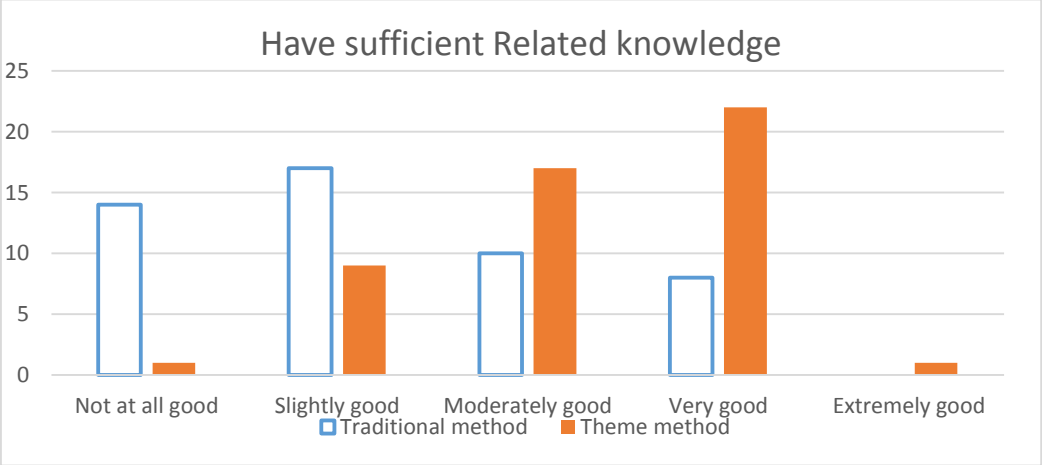

Figure 35. Students having sufficient related knowledge

In figure 36. , students in traditional methods get bored in class with the teacher reading the textbook, but by using flipping classroom from the theme method, students get to interact more with the teacher and peers.

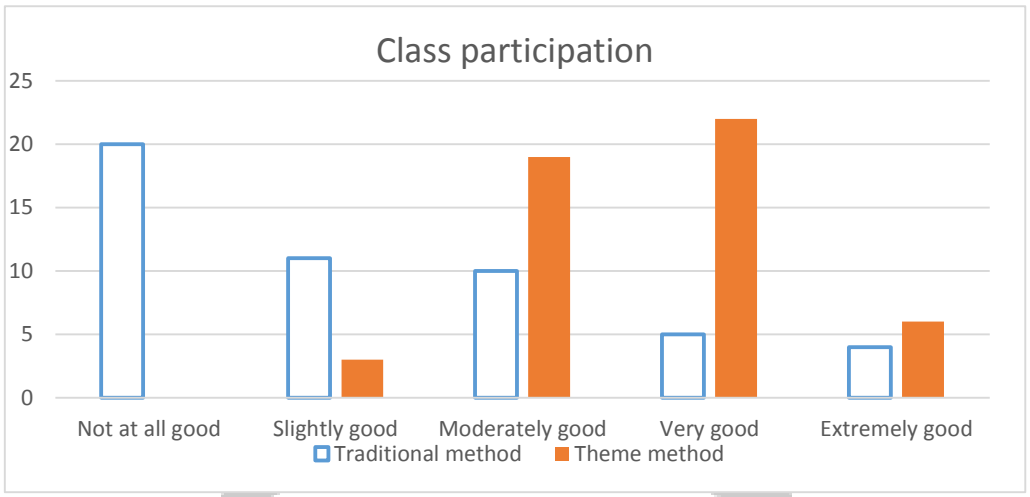

Figure 36. Student's participation in class

In figure 37. , students in traditional methods don't really get feedbacks by peers and teachers, but in the theme method, by flipping the classroom, students have to interact with each other to answer questions or to discuss with the teacher.

Figure 37. Students have positive feedbacks by peers

The results of the charts has clearly proved that the method has a slightly better effect than before.

At the prophase questionnaire students wrote that they actually did not have interest or why and how to use the contents in this class, saying the teacher only stood there reciting the textbook and had almost zero interact, but changing the method by flipping class and adding Creative thinking, students start to gain more interactive with

each other and also with the teacher, and willing to think more when they were randomly asked by the teacher, but some students think Taiwan students are too shy using the method to start class will have more challenges in the future .

Chapter 5. Conclusion and Future Work

In this thesis we have been discussing students in Taiwan with the traditional curriculum design and process, the computer program teaching methods mostly adopted the demonstration teaching, followed by demonstration teaching steps. We did a field test by putting the same method in teaching a class in college and had some great results. Most of students were not able to the capability of problem solving. We integrate creative problem solving training into programming teaching by dividing it into two different courses , through the method of observation, understand the problem first, fully thinking, and using the generating ideas concepts. In the CPS course we train students through a system software development project. It will involve comprehensive thinking using problem solving method as well as action planning practice, training students through a whole software development process. In the programming course we let students learn and practice programming skills in a more interesting way, to use popular coding programs letting students get into situation quicker, by repeat practicing, interact, share and discuss coding process with peers, it is easier for students get interested to step into the domain of Information Technology and not going to setback.

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Appendix

Appendix I

課程問卷

這份問卷主要是以你自己上各種課程下，對自身狀況的評量問卷，請依照直覺下的答案作答，所有題目為單選題，請認真填寫已助於研究計畫的進行。

	不好 1	還可以 2	普通 3	很好 4	非常好 5
1.對於自己的學習目標清楚	□	□	□	□	□
2.我學習到的東西可以運用在專業上	□	□	□	□	□
3.我了解學習的內容	□	□	□	□	□
4.我會運用範例, 小考, 案例分析來幫助學習	□	□	□	□	□
5.我對自己問題解決能力	□	□	□	□	□
6.我會使用輔助媒體，加強學習效果	□	□	□	□	□
7.我有足夠充分的時間來完成學習目標	□	□	□	□	□
8.我會使用的額外資源，以滿足學習的需要	□	□	□	□	□
9.我準備充分	□	□	□	□	□

10.我有足夠的相關知識	□	□	□	□	□
11.我在課堂上的參與度	□	□	□	□	□
12.我有得到同儕正面的回應	□	□	□	□	□

目前學習上遇到的問題:

Appendix II.

實驗教案

老師: 洪晟勛

教學策略	翻轉教室, 同儕學習, 創造力思考			
學科領域	資訊科技概論			
主題名稱	SaaS			
教學方式	了解生活周邊電腦硬體並且進一步認識			
資源/設備/書籍	投影機、數位教學資源(影片與電子書等)、資訊科技概論課本			
教學評量	課堂情境問答			
教學總時間(分)	50 分鐘			
教學目標	1. 能了解 SaaS 的概念 2. 能區別出 SaaS 與 ASP 3. 能了解 SaaS 的特性 4. 能了解 SaaS 的成長對於產業的變動			
單元目標	**教學活動**	**教材**	**教具**	**時間(分)**
1. 能了解 SaaS 的概念 2. 區別出 SaaS 與 ASP 3. 能了解 SaaS 的特性	1. 讓學生以主觀的想法去嘗試了解 SaaS 的作用 2. 區別出 ASP 與 SaaS 的不同 3. 舉例出服務供應商 4. 討論其特性	教科書	投影機	30
單元目標	**綜合活動**	**教材**	**教具**	**時間(分)**
1. 能了解 SaaS 的成長對於產業的變動	1. 以情境方式討論如果 SaaS 服務開始普及在大眾時, 對現金的社會上的哪些產業造成影響		電腦	10