優質教育基金
Quality Education Fund

M:FR/C

計劃總結報告	計劃編號 ：2014/0150

甲部

計劃名稱：電腦編程容易學 (2 Easy Coding)
學校名稱：港澳信義會小學 (Hong Kong and Macau Lutheran Church Primary School)
計劃進行時間：由 09/ 2015 *(月/年)* 至 08/2016 *(月/年)*

乙部

填寫此部份報告前，請先詳閱讀「優質教育基金計劃總結報告填寫指引」。

請另頁(A4 紙)書寫 ，就以下項目作出總結報告：

1. 達成目標
2. 計劃對學習成效、專業發展及學校發展的影響
3. 自我評鑑計劃的成本效益，需清楚列出有關指標及衡量準則
4. 成品及推廣模式，及外間對那些推廣活動的反應
5. 活動一覽表
6. 計劃實施時所遇到的困難及解決方法

計劃負責人姓名：　　受款人姓名*：

簽名：　　簽名：

日期：　　日期：

**計劃總結報告須經「網上計劃管理系統」提交。一經提交，報告將被視為已經由校監／機構主管或代表機構簽署優質教育基金撥款協議書的人士確認。*

優質教育基金
Quality Education Fund

優質教育基金總結報告

1. 能否達成目標

說明目標	與目標相關的活動	達標程度	達到目標的證據或指標	未能達到目標的理由
<u>目標一</u> 開發一個全新的教材套，支援推廣電腦編程教學	1. 四年級校本課程：　初階 2. 五年級校本課程：　進階 3. 六年級校本課程：	全部達到	1. 100% 小四學生於學習　初階後能夠製作一個互動遊戲 2. 100% 小五學生於學習　進階後能夠製作一個複雜的互動遊戲 3. 100%小六學生於學習　後能夠製作互動故事或數碼遊戲	
<u>目標二</u> 透過多元化的學習活動，增強學生的學習動機	1. 「翻轉教室」自習課程 2. 平板電腦應用程式：「超時空要菜」	全部達到	1. 超過90%的參與學生曾在學校／家裡觀看過翻轉教室短片。45位受訪學生當中，有超過50%的學生認為短片可幫助他們學習，增強他們學習編程的動機 2. 100%參與學生曾玩過「超時空要菜」，並認為遊戲有趣，增強他們學習編程的動機	
<u>目標三</u> 透過電腦編程教學，加強訓練學生邏輯思維	1. 參與學生須於學習編程前及後回答「學校發展與問責」平台中的「創造力」、「批判性思考」及「解難能力」問卷	全部達到	1. 學生學習編程後，「創造力」、「批判性思考」及「解難能力」的數據均有提升	

目標四 透過開發教材套提升老師對電腦編程教學的認識及了解	1. 透過問卷調查，收集參與教師意見	全部達到	1. 100%參與教師認為自己有能力教授電腦編程	

2. 計劃影響

本計劃的目的是開發一套完整的電腦編程教學(Computer Coding)教材套。目標為支援推廣電腦編程教學；透過多元化的學習活動，增強學生的學習動機；透過電腦編程教學，加強訓練學生邏輯思維及透過開發教材套提升老師對電腦編程教學的認識及了解。本計劃對象為本校小四至小六學生，受惠人數約 360 人。本校致力推廣電腦編程教學，並透過工作坊推廣本計劃至其他有興趣教授電腦編程教學的學校。現按照証據為本的方法，從以下角度評鑑計劃對學習成效／專業發展／學校發展的影響：

– 引發與其他學校／專業團體的協作機會

本計劃評鑑工作由　　學院資訊及科技教育部助理教授　　博士帶領。通過前測及後測，收集學生於電腦編程學習下的數據。並透過問卷調查，分析電腦編程學習的教學安排能否協助學生發展自學能力。有關分析學生學習能力部分，請參考由　博士撰寫的報告(附件一)。

教師方面

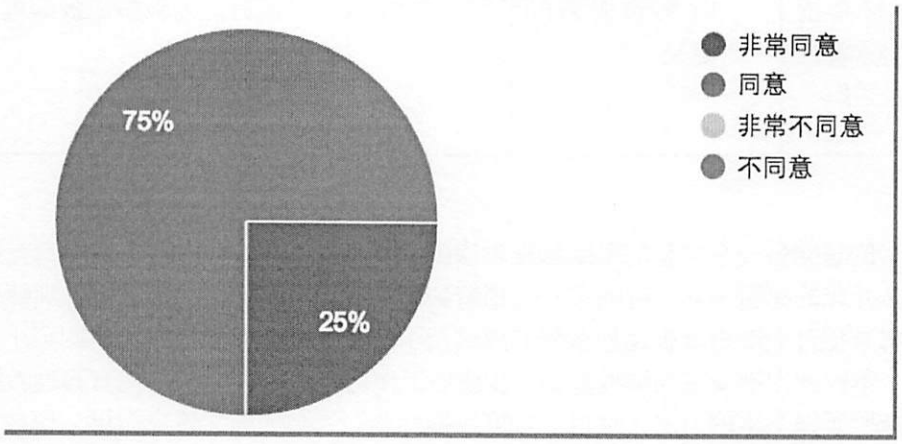
– 為教師提供更多培訓機會，促進教師的專業發展及加強教師的成功感

本校有十位教師參與本編程計劃。參與計劃前，本校教師曾參與三次相關培訓：

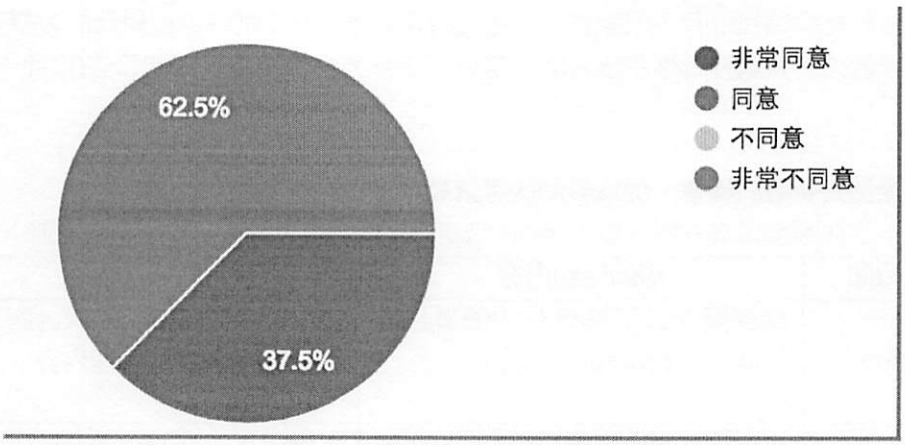
培訓時間	培訓活動內容	成果
培訓一 （11/2015）	課程簡介及了解學生的學習目標及觀看「翻轉教室」短片	參與老師能夠明白是次計劃目的，了解其需要教授學生的課程內容
培訓二 （12/2015）	試玩校本平板電腦遊戲「超時空要菜」	透過試玩「超時空要菜」，了解學習編寫不同的模擬電腦編程的概念、學習預測電腦程式的結果、除錯等教學活動
培訓三 （01/2016）	測驗	教師須在指定時間內，完成製作一個　　或　　遊戲

參與計劃前，有老師在抽樣訪談中表示自己沒有信心教授電腦編程。完成三次培訓後，老師了解整個課程的目的，經過親自製作一個編程遊戲後，所有參與教授的老師均於訪談中表示他們有信心教授電腦編程。而整個計劃完成後，所有老師在問卷調查中表示，他們認為自己有教授電腦編程的能力（圖一）及願意繼續教授電腦編程（圖二）。可見是次計劃不但能促進教師的專業發展，更能夠加強本校教師教授電腦編程的成功感。

（圖一）：我認為我有能力教電腦編程



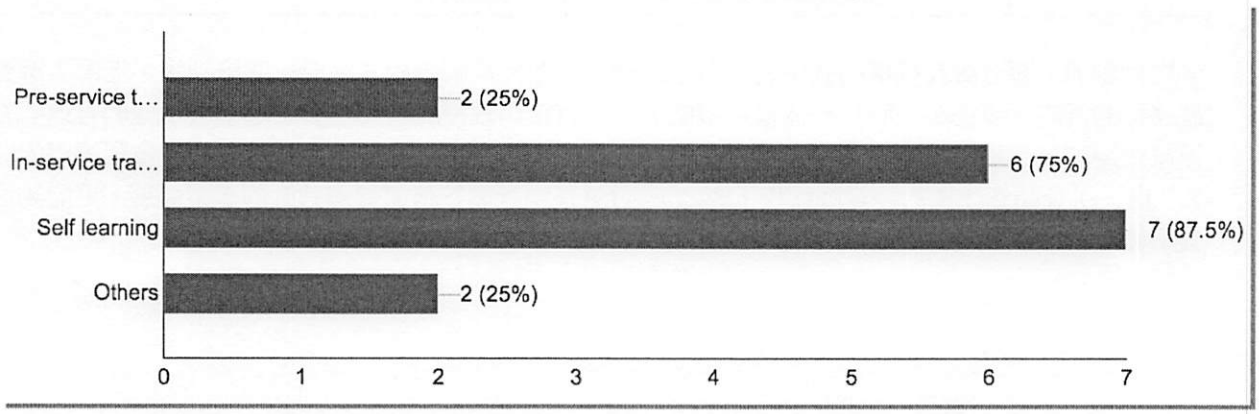
（圖二）：我願意繼續教電腦編程



– **開拓教師的視野**

參與計劃的老師當中，只有 25%表示曾於職前接受過電腦編程教學訓練，其餘 75%均表示，其電腦編程知識來自在職培訓或自學（圖三）。由此可見，參與此計劃，可豐富教師本科知識外，亦鼓勵教師積極進修及學會自學。

（圖三）：我從以下途徑學習電腦編程



– 促進學校團隊精神及提升學校整體形象

是次計劃由本校電腦科科主任成立計劃小組帶領進行，組員包括一名本校的電腦科老師及顧問 [redacted] 博士。當教師遇到教學上的困難，小組會透過不同形式的協助，與組員一起解決困難。

另外，本校藉著三次工作坊「資訊科技教育教學法系列：運用校本數碼遊戲製作教材套以促進自主學習（小學）」，介紹本計劃予有興趣推廣電腦編程的學校，另參與 2016 年 6 月 24 日及 2016 年 11 月 11 日工作坊的教師中，有超過 80%對工作坊表示滿意(表一、表三及表五)；有超過 80%教師認為，工作坊課程內容切合主題（表二、表四及表六）。亦有參與工作坊老師給予正面的質性評價：「It was such a(n) inspiring talk that you have given.」、「Teachers show their professionalism. A good session.」及「great afternoon with lots of information, thank you.」這是對本校團隊的肯定，亦進一步確立我校在小學電腦編程方面的貢獻。

Comments on the course [5=highest rating; 1=lowest rating] 對本課程的意見 [5=最高評分; 1=最低評分]	
Overall, I was satisfied with this course. 總括來說，我對這課程感到滿意(整體評估)。	
評分	%
5	20%
4	80%
3	0%
2	0%
1	0%
0	0%
Total	100%

（表一）：2016 年 6 月 24 日工作坊

Comments on the course [5=highest rating; 1=lowest rating] 對本課程的意見 [5=最高評分; 1=最低評分]	
The content was relevant to the title of the course. 課程內容切合主題。	
評分	%
5	20%
4	80%
3	0%
2	0%
1	0%
0	0%
Total	100%

（表二）：2016 年 6 月 24 日工作坊

Comments on the course [5=highest rating; 1=lowest rating] 對本課程的意見 [5=最高評分; 1=最低評分]	
Overall, I was satisfied with this course. 總括來說，我對這課程感到滿意(整體評估)。	
評分	%
5	27.27%
4	63.64%
3	9.09%
2	0%
1	0%
0	0%
Total	100%

（表三）：2016 年 11 月 11 日工作坊

Comments on the course [5=highest rating; 1=lowest rating] 對本課程的意見 [5=最高評分; 1=最低評分]	
The content was relevant to the title of the course. 課程內容切合主題。	
評分	%
5	36.36%
4	54.55%
3	9.09%
2	0%
1	0%
0	0%
Total	100%

（表四）：2016 年 11 月 11 日工作坊

Comments on the course [5=highest rating; 1=lowest rating] 對本課程的意見 [5=最高評分; 1=最低評分]	
Overall, I was satisfied with this course. 總括來說，我對這課程感到滿意(整體評估)。	
評分	%
5	22.22%
4	77.78%
3	0%
2	0%
1	0%
0	0%
Total	100%

（表五）：2016 年 11 月 25 日工作坊

Comments on the course [5=highest rating; 1=lowest rating] 對本課程的意見 [5=最高評分; 1=最低評分]	
The content was relevant to the title of the course. 課程內容切合主題。	
評分	%
5	33.33%
4	66.67%
3	0%
2	0%
1	0%
0	0%
Total	100%

（表六）：2016 年 11 月 25 日工作坊

學生方面

博士根據本校情意及社交表現評估(APASO)數據及學生面談的分析及觀察，得出以下結果及評價：

1. 學生在學習電腦編程課程後，他們的創造性思維，批判性思維和解決問題的技能略有提昇；
2. 從電腦編程測試中得知學生的編程知識和基本的計算思維概念知識有所增加；
3. 學生不拒絕學習電腦編程，通過學校設計的電腦編程課程，他們在課程中學會如何編寫程式；
4. 從問卷中得知，學生
   a. 有自信學習電腦編程；
   b. 覺得學習電腦編程不太困難；
   c. 認為電腦編程是有用的
   d. 受父母和同伴的影響，學習電腦編程；
   e. 能夠接受外界幫助學習編程；
   f. 有興趣學習電腦編程；
   g. 有意繼續學習編程；
5. 學生能夠通過電腦編程活動，學習到一些基本技能。

總括而言，這項優質教育基金計劃是成功的。在過去一年中，此計劃亦能培養學生的計算思維技能。另外，透過觀察及分析，是次計劃對學生有正面影響，結果亦顯示他們積極學習電腦編程。如果研究能持續更長的時間，可以觀察到更有趣的結果：如課程設計、學習動機、對其他學科的影響，如數學和學生在非編程日常生活中的解決問題的能力。

博士建議學校應該繼續向學生宣傳編程素養，並利用教師在編碼教育方面的經驗來幫助學生學習電腦編程。

有關觀察及分析詳情，請參閱由　　博士撰寫的報告（附件一）

3. 自我評鑑計劃成本效益

表二: 預算核對表

預算項目 *(根據協議書附表 II)*	**核准預算** **(甲)**	**實際支出** **(乙)**	**變更** **[(乙)-(甲)] / (甲)** **+/− %**
職員薪酬	268,942 元	268,941.75 元	0%
器材	0 元	0 元	0%

現就以下各方面評鑑計劃的成本效益：

- **資源的運用(例如器材、申請學校/參與學校的人力資源等)**
  透過此計劃，本校聘請了一位代課教師，電腦科主任利用因代課老師而騰出的空間用來製作「數碼遊戲課程」的教學框架，及招標編寫電腦編程應用程式「超時空要菜」，就相關教材進行試教及提出改善意見。

- **計劃所建構的學習課程及資料的延續性**
  此計劃所建構的學習課程及資料均可重複使用，其他有興趣推廣電腦編程之學校可以按其需要，自行修訂有關教學內容。

- **當其他學校重做計劃時，不須另外注資的開支項目(包括計劃的開辦成本、備用成品等)**
  除影印紙本筆記外，其他學校重做此計劃時，不須另外注資。

- **以較低成本達致相同效益的其他辦法**
  有興趣參與此計劃的學校，可派發電子筆記予學生，減低成本。

受款人必須填寫本附件內表二的預算核對表，與報告一併遞交。關於預算項目的分類辦法，請參照計劃協議書附件二。

請就以下各方面評鑑計劃的成本效益：

- 按直接受惠人士數目計算的單位成本
- 計劃所建構的學習課程及資料的延續性
- 當其他學校重做計劃時，不須另外注資的開支項目(包括計劃的開辦成本、備用成品等)
- 以較低成本達致相同效益的其他辦法

4. 可推介的成果及推廣模式

計劃成果的推廣價值

項目詳情 (例如 種類、名稱、數量等)	成果的質素 及推廣價值評鑑	舉辦的推廣活動 (例如 模式、日期等) 及反應	是否值得優質教育基金推介及可供推介的可行性？如值得，請建議推廣模式
一套三冊「　　初階」、「　　進階」及「　　」的教材套及網上自學平台：「翻轉教室」短片	已修訂所有教材套；值得推廣	於 2016 年 6 月 24 日、11 月 11 日及 11 月 25 日的工作坊分發給約 75 名參加者，有部分參加者表示會嘗試在學校使用此教材套； 約 10 名本校教師曾在校內使用此教材套	可透過網頁或工作坊形式推介此教材套
一個平板電腦遊戲：「超時空要菜」	值得推廣	於 2015-2016 學年於校內推廣給全校師生，現可於　　下載	可透過網頁或工作坊形式推介此平板電腦遊戲

5. 活動一覽表

活動性質 *(例如 座談會、表演等)*	概略說明 *(例如 日期、主題、地點等)*	參加人數				參加者的回應
		學校	教師	學生	其他 (請註明)	
工作坊	24/06/2016 11/11/2016 25/11/2016		20 20 18			24/06/2016、11/11/2016 及 25/11/2016 工作坊： 超過 80%參加者滿意工作坊內容。有參加者認為是次工作坊所教授的軟件容易，會於學校推廣。

6. 困難及解決方法

困難	解決方法
1. 預算支出（員工開支）： 基於行政安排，學校由 2015 年 9 月已聘請相關代課老師，其薪金為每月 $ 25505（薪級點 14），與預算的每月薪金 $ 23285 有差距	由本校填補代課老師薪金差距（詳情請參閱財政報告）
2. 時間表： 原計劃定於 12/2015-02/2016 其間進行電腦編程課程試教，基於學校行政安排，不能橫跨上下學期進行。	與校方相討，本校將整個課程順延至 2015-2016 年度下學期，時間為 01/2016-05/2016。
3. 改善及推廣： 原計劃定於 03/2015-08/2015 收集意見、改善教材套及舉行發佈會	礙於整個課程順延至 2015-2016 年度下學期舉行，本計劃於 06/2015－11/2016 進行收集意見、改善教材套及舉行發佈會

附件一

Appendix 1: Evaluation Report on the Student Learning Performance and Perception in Computer Coding

I. Introduction

In this evaluation report, it is to supplement the QEF Project "2 Easy Coding" and address the student learning performance (i.e. motivation, comprehension competence and learning performance, etc), and the learning interest and motivation based on the coding experience in this project. Through analyzing the outcomes of students in this project, it helps understand better the effectiveness of this project in promoting coding with the new developed "Computer Coding Apps" (電腦編程應用程式) and other selected tools (i.e. Kodu and Scratch) for teaching the coding concept to children in primary 4 to primary 6.

This report is only served as a sub-section to the final report to QEF, which does not contain all the information outside of this domain concerning the student performance and perception. In addition, the original proposal was not designed in my own capacity, thus the validity and reliability during the data collection and analysis may be uncontrollable. However, the insights from conducting a preliminary analysis toward these data may be helpful to the future study and consideration when promoting coding education in Hong Kong.

In this report, it will first describe the basic research design and data collection protocols. Then the data analysis will be provided in details. Results of the analysis will be presented with some further observation in the discussion section. A conclusion will be given at the end of this report.

II. Research Design and Methods

This study aims to evaluate the student competence in computer coding, attitude toward coding (interest and motivation), learning effectiveness and their acceptance to computer coding. Based on the original project proposal, there are several instruments used in the evaluation and data collections.

APASO

Assessment Program for Affective and Social Outcomes (2nd Version) (APASO-II) system can collect data from the E-platform for School Development and Accountability (ESDA) system provided by the EDB to have self-measurement on Learning Competency such as problem-solving skills, creativity, critical thinking and learning motivation for the first hand-reference, which may have a wider comparative data (See Fig. 1)

The details of the questionnaire are included in this report for reference. Based on the information provided by the project school, it was administered by the school teachers during two periods, 18 February and 30 March 2016; 28 April and 31 May 2016. In between, coding lessons were conducted at the schools. The APASO, although cannot fully evaluate the actual learning competency from the observer point of view, it serves the purpose of studying how the students measure themselves in coding education. Other measurement tools will capture the evaluation from the researcher's and teacher's perspective. The coherence can then be identified based of the bidirectional analysis.

Scale Name	Subscale Name	Item	Time Est.	Objective	Target group
Learning Competency					
Developed by team members	• Creative Thinking	8	3-4mins	This subscale obtains index on creative thinking of Hong Kong primary school children.	P3-6
Developed by team members	• Critical Thinking	5	2-3mins	This subscale obtains index on critical thinking of Hong Kong primary school children.	P3-6
Camp Adventure Scale for Hong Kong School Students (Chin et al., 2008)	• Problem Solving	8	2-3mins	This subscale provides a measure of students' strategic approach to problem solving.	P3-6

Figure 1. Self-evaluation of learning competency in APASO

Primary Scales

Learning Competency

Class : _____

Gender : Male / Female

Please indicate whether you agree with what is stated in each sentence. For example, if you strongly agree with the following sentence, you should fill in the fourth circle.

	Strongly Disagree	Disagree	Agree	Strongly Agree
Creative Thinking				
1. I usually view things in ways different from most people.	①	②	③	④
2. I have the urge to do the most common things in new ways.	①	②	③	④
3. I am most delighted when I see that my successes are based on original ideas.	①	②	③	④
4. I like creating new things.	①	②	③	④
5. I am sensitive to differences among similar objects.	①	②	③	④
6. I always have a flow of new ideas.	①	②	③	④
7. I can turn a simple story into a brilliant one with ease.	①	②	③	④
8. I can easily think of different solutions to the same problem.	①	②	③	④
Critical Thinking				
9. I need to know the reasons for doing things.	①	②	③	④
10. I rely on my own judgment to agree to things.	①	②	③	④
11. I am confident in being able to solve complex problems.	①	②	③	④
12. I can follow complicated steps to a solution.	①	②	③	④
13. I will agree with authorities only when I am given satisfactory reasons.	①	②	③	④
Problem Solving				
14. I like to use different methods to solve problems.	①	②	③	④
15. I select the best method to complete tasks.	①	②	③	④
16. I compare the effectiveness of different methods of problem solving.	①	②	③	④
17. I focus on the main issues in order to solve the problem.	①	②	③	④
18. I consider the problem from multiple perspectives.	①	②	③	④
19. I find out why a problem solving method does not work.	①	②	③	④
20. I seek help where appropriate in order to solve problems.	①	②	③	④
21. I learn how to solve problems from others.	①	②	③	④

Figure 2. Questionnaire of learning competency in APASO

Pre-Test/Post-Test (Subject Test)

Each grade was given a written pre-test and post-test before and after the coding lessons. The tests were designed by the school teachers, and the purpose was mainly to evaluate the knowledge of students in solving some tasks based on the given situations. For example, the question illustrated in Figure 3 asks how could the astronaut could walk to the position of the star. The choices were given about different steps which may achieve the goal. The aim of the pre-test and post-test were to find out in general the progress of students is solving coding challenges on written form. The instrument is limited to obtain the basic descriptive statistic, which will be given in the following section.

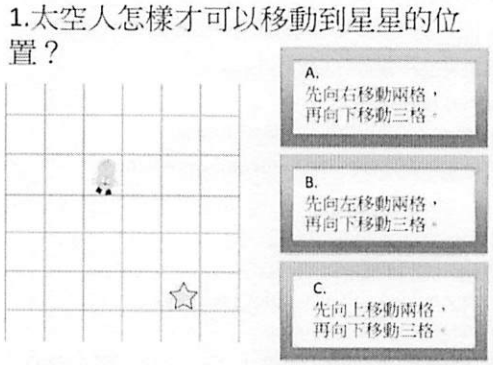


Figure 3. Sample question from pre-test for primary 4 students

Coding Acceptance Questionnaire

A customized self-developed questionnaire was designed to obtain the insight about the acceptance of students in coding activities based on the experience in this school coding lesson. The questionnaire is attached in Appendix 2 for reference. In this instrument, the objective is to understand the constructs to cause behavioral intention of children in coding. There are 7 constructs with some associated statements concerning the following aspects:

1. SE – Self Efficacy
2. SI – Social Influence
3. PU – Perceived Usefulness
4. PEOL – Perceived Ease of Learning

5. ES – External Support
6. ATC – Attitudes Towards Coding
7. BILC – Behavioral Intention to Study Coding

Due to the scope of this report, only descriptive statistic will be measured and provide basic insight about how much students accept the coding based on these lessons. The students were given access to this questionnaire through Google form, and they were asked to complete it during a class time to ensure that teachers could provide technical support to the students.

This questionnaire has been customized based on my existing works in coding education, and the contents in this version were slightly modified to meet the needs in this evaluation. By using these constructs, the results will indicate the perception and acceptance of this coding experience. More analysis, such as path analysis or structural equation modeling, could be conducted based on this data to find out more different hypothesis of the constructs' causal effects to the behavioral intention.

Focus-Group Interview

The objective of the interview is to obtain further insights through qualitative analysis and find out the impression of students in coding. In each class of each grade, 3 students (High, middle, low in general academic performance) were selected before attending the first coding lesson, and another 3 students based on the same criteria were invited after the end of the last coding lesson, to attend a focus group interview. Since gender difference is not our major concern, it will not be distinguished. The interview was conducted by the school teachers, but not their own teacher in the coding lesson to avoid any conflict of interest or sense of embarrassment. The basic questions are as follows:

<u>Before the coding lesson:</u>

1. Do you know any software tool for coding?
2. Have you used Kodu or Scratch before?
3. What do you think the subject that coding is closely related? Why?
4. What can you learn from coding and what skills can be enhanced?

<u>After the coding lesson:</u>

1. Do you know any software tool for coding?
2. How interesting do you think the coding lesson (0 = Very boring; 10 = Very interesting)
3. What do you think the subject that coding is closely related? Why?

4. What can you learn from coding and what skills can be enhanced?

III. Context and Data Analysis

Each grade had 124 students, and they all participated in the 8 coding lessons, and each lesson was 35 minutes delivered by 5 different teachers who were previously trained to teach with the coding tools. The details of the coding lessons would not be included in this report, but the school should have documented the plans of each lesson and the activities. No class observation was conducted by the external consultant. All the data were collected by the school teachers, and were shared with me through cloud system in Google Drive. For more details concerning the context, it should be referred to the main final report by the school. In this evaluation report, it considers how the coding intervention may have changed the attitude and acceptance toward coding, and the skill gained from the lessons in a general sense. However, there could be some unknown contexts which may not be shared nor discussed with the consultant for further analysis.

Due to the scope of this project, descriptive statistics and recursive abstraction will be used mostly in this report for quantitative data and qualitative data respectively. However, I have taken the Factor Analysis on the questionnaire, and more rigorous analytical approaches could be conducted in the future work with inferential statistics and other *qualitative coding* techniques, which may provide with a more sophisticated analysis to the original data. Yet, this is beyond the requirement of this project and the time capacity given in the invitation.

Nevertheless, it is believed that this evaluation report will provide the preliminary analysis of students' perspectives and performance, and the results can be further studied if necessary with more time and staffing resources given.

IV. Evaluation Results

APASO

Based on the pre-test and post-test comparison, we can see that there are slightly increase in the students' creative thinking, critical thinking, and problem solving in overall (see Table 1). Note that creative thinking has been reported to have a higher change compared to other skills. On the other hand, it seems that the female students are reported to have a larger change of difference between pre-test and post-test in all three aspects. Particularly, female students have a bigger change in their critical thinking. This may indicate that coding has more influence to the female students in general. More reasons

could be studied to find out the reasons behind the differences. However, it is also worth to notice that coding lessons seem to create a positive standard deviation (S.D.) difference in overall and among different genders. This may show that some students may be improved more in terms of these three skills, and their self-evaluation scores have spread further from each other. It may also indicate that some students may have a better improvement than others, possibly due to their interest and motivation to develop further skills. Nevertheless, more studies could be done to analyze in depth.

Table 1: Overall Learning Competency of Students in Coding at School

Subscale	*Item*	*Overall*	*Overall (S.D.)*	*Gender*		*Gender (S.D.)*	
				Male	*Female*	*Male*	*Female*
Creative Thinking	Pre-test	2.78	0.52	2.79	2.77	0.59	0.44
	Post-test	3.05	0.6	3.04	3.05	0.64	0.55
	Difference	0.27	0.08	0.25	0.28	0.05	0.11
Critical Thinking	Pre-test	2.91	0.52	2.93	2.90	0.57	0.47
	Post-test	3.10	0.58	3.05	3.11	0.63	0.52
	Difference	0.19	0.06	0.12	0.21	0.06	0.05
Problem Solving	Pre-test	2.99	0.47	2.97	3.00	0.50	0.43
	Post-test	3.18	0.58	3.13	3.23	0.63	0.51
	Difference	0.19	0.11	0.16	0.23	0.13	0.08

Pre-Test/Post-Test (Subject Test)

In general, the students in each grade have improved their coding subject test score through the mean. Particularly, the primary 4 students have the largest change. The statistic can be referred to the Table 2. Thus, the coding lessons could deliver the course contents and students in general could answer the questions more.

Table 2: Overall Learning Competency of Students in Coding at School

Subscale	*Item*	*Test Score Mean*
Primary 4	Pre-test	68.7
	Post-test	81.1

	Difference	12.4
Primary 5	Pre-test	63.6
	Post-test	74.5
	Difference	10.9
Primary 6	Pre-test	79.8
	Post-test	80.0
	Difference	0.02

Coding Acceptance Questionnaire

In this questionnaire, the demographic information is presented in Table 3, and the descriptive statistics are presented in Table 4. The results show that most students tend to agree that learning coding is enjoyable, and they feel they are capable in performing well in coding activities. Perhaps they may need more help and support from external partners such as teachers, parents and peers. In general, these students are willing to continue to participate in coding activities.

Table 3: Demographic information (Questionnaire)

Item	*Result*
Number of participating schools	1
Number of participating students	316
Gender	Male (164) Female (152)
Age	8 (0) 9 (50) 10 (104) 11 (118) 12 or above (43)
Grade level	P4 (106) P5 (93) P6 (117)

Average time spent on coding last month (in hours)	0 (58)
	1-5 (196)
	6-10 (35)
	11-15 (13)
	More than 15 (14)
Number of extra-curricular activities	0 (32)
	1 (80)
	2 (87)
	3 (49)
	4 or above (68)
Self-concept of academic performance	Below average (35)
	Average (178)
	Above average (103)

Table 4: Descriptive statistics of the constructs (N=316)

Construct	*Item Code*	*Mean*	*S.D.*	*Kurtosis*	*Skewness*
Self-Efficacy (SE)	SE1	3.70	1.02	-0.390	-0.397
	SE2	3.68	1.09	-0.470	-0.476
	SE3	3.53	1.11	-0.700	-0.317
Social Influence (SI)	SI1	3.41	1.17	-0.713	-0.257
	SI2	3.12	1.27	-0.908	-0.165
Perceived Usefulness (PU)	PU1	3.93	1.08	0.201	-0.868
	PU2	3.18	1.16	-0.700	-0.151
	PU3	3.59	1.14	-0.521	-0.470
Perceived Ease of Learning (PEOL)	PEOL1	3.17	1.21	-0.754	-0.094
	PEOL2	3.58	1.15	-0.492	-0.493
	PEOL3	3.29	1.21	-0.925	-0.153
External Support (ES)	ES1	3.35	1.20	-0.537	-0.437
	ES2	3.36	1.14	-0.442	-0.377
	ES3	3.31	1.17	-0.722	-0.147
	ES4	3.17	1.18	-0.674	-0.144
Attitude Towards Coding (ATC)	ATC1	3.76	1.25	-0.629	-0.666
	ATC2	3.62	1.31	-0.970	-0.493
	ATC3	3.58	1.18	-0.444	-0.508
Behavioral Intention to Study Coding (BISC)	BISC1	3.38	1.22	-0.757	-0.305
	BISC2	3.53	1.28	-0.873	-0.395

In the statistics, we also have tested whether the data generated a relatively fit to normal distribution (i.e. kurtosis and skewness are equal to zero for normal distribution). Skewness is a measure of

symmetry, or more precisely, the lack of symmetry. A distribution, or data set, is symmetric if it looks the same to the left and right of the center point. Kurtosis is a measure of whether the data are heavy-tailed or light-tailed relative to a normal distribution. Based on some common criteria, |Kurtosis| < 10 and |Skewness| < 3 indicate that the data are spread evenly without extreme cases. Negative values for the skewness indicate data that are skewed left, and negative kurtosis indicates a "light tailed" distribution, so it is indeed in our case.

Table 5: Factor analysis and convergent validity

Construct	*Item Code*	*Factor loading*	*AVE*	*Cronbach's alpha*	*Composite Reliability*
Self-Efficacy (SE)	SE1	0.738	0.569	0.816	0.739
	SE2	0.728			
	SE3	0.632			
Social Influence (SI)	SI1	0.794	0.587	0.701	0.739
	SI2	0.737			
Perceived Usefulness (PU)	PU1	0.666	0.468	0.732	0.725
	PU2	0.725			
	PU3	0.659			
Perceived Ease of Learning (PEOL)	PEOL1	0.718	0.612	0.723	0.824
	PEOL2	0.715			
	PEOL3	0.900			
External Support (ES)	ES1	0.828	0.525	0.770	0.920
	ES2	0.865			
	ES3	0.817			
	ES4	0.716			
Attitude Towards Coding (ATC)	ATC1	0.849	0.700	0.928	0.875
	ATC2	0.858			
	ATC3	0.801			
Behavioral Intention to Study Coding (BISC)	BISC1	0.779	0.586	0.845	0.739
	BISC2	0.752			

Note: Most of the factor loadings > 0.7; Most AVE values > 0.5; All composite reliability values >0.7; Cronbach's alpha > 0.7;

Table 6: Discriminant validity (correlation matrix with diagonal elements replaced by square

root of AVE)

	SE	SI	PU	PEOL	ES	ATC	BISC
SE	**0.75**						
SI	0.46	**0.77**					
PU	0.49	0.50	**0.68**				
PEOL	0.67	0.38	0.39	**0.78**			
ES	0.40	0.60	0.50	0.42	**0.72**		
ATC	0.66	0.43	0.64	0.58	0.45	**0.83**	
BISC	0.58	0.42	0.62	0.53	0.45	0.83	**0.77**

Factor analysis on the questionnaire

The data were first analyzed using a factor analysis to find out if the factors are well categorized. In this analysis, a recommended lower bound of 0.45 for AVE is used, while the recommended lower bounds for factor loading, Cronbach's alpha, and composite reliability are 0.70. In the analysis turned out that three of the factor loadings were marginal at 0.632 (SE3), 0.666 (PU1) and 0.659 (PU3) indicating that the responses to these questions might be slightly inconsistent with other answers tapping the same construct. One possible reason is that the students may not fully understand the questions presented to them in their second language, or that the students interpreted the questions in a different way to how they were intended.

The result of this factor analysis is given in Table 3 for a convergent validity check. In this table, the factor loadings are given for each item. The average variance extracted (AVE), Cronbach's alpha, and composite reliability are given for each construct, and the resulting values are mostly above the threshold. That means, this questionnaire provides a valid data to the study. To check the discriminant validity, the lower triangular correlation matrix of the composite scores of the constructs is presented with its diagonal elements replaced by the square root of the AVE for each construct. The result is shown in Table 4. The fact that the diagonal elements are larger than all the off-diagonal elements in its own row and column indicates that the constructs correlate more with their own items than with other constructs. Discriminant validity is thus verified in our

process. In other words, the data are valid in our evaluation.

Focus-Group Interview

Based on the interview result, it shows that students in general have an awareness of the common coding tools such as Scratch and Kodu, while some students in the post-coding interview still did not know what tools could be used for coding, unless they were given choices to pick. It is reasonable for primary students at their age to only know the tools rather than generalizing different tools for coding. Nonetheless, most of the students recognizing coding should be a part of the learning activities in computer lessons, and it is somehow related to software programs. In terms of the awareness of how coding can enhance generic skills, here are the list of key words mentioned in the interview before and after coding lessons:

Table 7: Key words mentioned in the focus-group interviews

Key words	*Pre-coding interview*	*Post-coding interview*
Game making	✓	✓
Computer control	✓	✓
Creativity	✓	✓
Arithmetic	✓	✓
Listening	✓	✓
Notetaking	✓	✓
Logical thinking	✓	✓
Learning ability	✓	✓
Coding competency	✓	✓
Communication	✓	✓
Problem solving	✓	✓
Decision making		✓
Debugging/finding error in code		✓
Information literacy		✓
English proficiency		✓
Cooperation/Collaboration		✓
Exploration and inquiry		✓

V. Conclusion and Summary

Based on my general observation in the analysis, here is the list of findings drawn from

the evaluation:

1. Creative thinking, critical thinking and problem solving skills have slightly been increased after the coding lessons;
2. The coding subject test shows an increase in the coding knowledge and basic computational thinking concept;
3. Coding activities are not rejected by the students, and they can learn how to code through the coding lessons designed by the school;
4. All the factors from the questionnaire show that students
    a. have self-confident to learn coding;
    b. feel that it is somehow not too difficult for them to learn;
    c. coding is useful
    d. are influenced by parents and peers to learn how to code;
    e. are able to receive external help in learning how to code;
    f. feel interested in learning how to code; and
    g. have intention to continue to learn how to code;
5. Students are able to recognize some of the common skills gained through coding activities.

In conclusion, this QEF project on coding education is successful in general to nourish the computational thinking skill for the children in the school in the past one year. The result is positive about the students learning, and there seems to have no negative impact on their perception about coding. If the study is continued over a longer period through research-based study, more interesting results may be observed, such as the curriculum design, learning motivation, impact to other subject learning such as mathematics, and students' problem solving skills in non-coding daily life situation.

I recommend that the school should continue to promote the coding literacy to students, and take the advantage of the teachers' experience in coding education to help students extend their learning in coding.

Appendix 2: 小學生對程式編寫的接受程度調查甲

部: 基本資料

1. 我的性別:

☐男 ☐女

2. 我的年齡:

☐8 歲 ☐9 歲 ☐10 歲 ☐ 11 歲 ☐ 12 歲或以上

3. 我目前就讀:

☐四年級 ☐五年級 ☐六年級

4. 在剛過去的一個月中，我每星期花在程式編寫的時間為:

☐0 小時 ☐1-5 小時 ☐6-10 小時 ☐11-15 小時 ☐多於 15 小時

5. 除學習程式編寫以外，我還參加了多少項課外活動及興趣班:

☐0 項 ☐1 項 ☐2 項 ☐3 項 ☐4 項或以上

6. 我覺得我的學業成績是屬於：

☐較差　　☐中等　　☐較好乙部：程式編寫的接受程度（請在適當的 ☐ 內加上 ✓ ）

非常同意=5，同意＝4，中立（既不同意也不反對）＝3，不同意＝2，非常不同意＝1

自我效力感量表 Self-Efficacy (SE)	1	2	3	4	5
1. 我覺得我能夠學會如何編寫程式。					
2. 我覺得我能夠製作自己的程式。					
3. 我覺得我能夠自己修改有錯誤的程式。					
社交影響量表 Social Influence (SI)					
4. 我覺得我的父母或老師希望我能學會程式編寫。					
5. 我覺得我的同學或朋友希望我能學會程式編寫。					
績效期望量表 Perceived Usefulness (PU)					
6. 我覺得學會程式編寫對我學習電腦有幫助。					
7. 我覺得學會程式編寫對我的學業成績有幫助。					
8. 我覺得學習程式編寫是有用的。					
易用期望量表 Perceived Ease of Learning (PEOL)					
9. 我覺得學習程式編寫是容易的。					
10. 我覺得「可視化編程工具」（例如: Kodu, 2 Easy Coding, Scratch 等）是一種容易使用的軟件。					
11. 我覺得我容易在圖書館或網上找到程式編寫的筆記（包括: 書籍、網頁、影片等）。					
外來支緩量表 External Support (ES)					
12. 我覺得我的父母或老師能幫助我解決學習程式編寫的困難。					
13. 我覺得我的同學或朋友能幫助我解決學習程式編寫的困難。					
14. 我覺得我的父母或老師鼓勵我學習程式編寫。					
15. 我覺得我的同學或朋友鼓勵我學習程式編寫。					
一般態度量表 Attitude Towards Coding (ATC)					
16. 我覺得程式編寫很有趣。					
17. 我喜愛學習程式編寫。					
18. 我覺得學習程式編寫是一項有意義的活動。					
行為意圖量表 Behavioral Intention to Study Coding (BISC)					
19. 我希望花多些時間學習程式編寫。					
20. 我將來會繼續學習程式編寫。					