

# Study on the Tutorial Efforts to Scratch Learning

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**Abstract**—Tutorial is an important tool for programming teaching. In this paper, we design a moderate learning tutorial based on the Scratch programming platform. In addition, we tested our proposed lessons in two Grade 6 classes of primary school. Then, we utilized the process data and submitted projects of students during the tutorial study to analyze the teaching effectiveness of tutorial and discover the relationship between learning process and final score. Experimental results and performance analysis show that effective learning in the learning process has a significant impact on the final score and different modules have different effective learning time.

## I. INTRODUCTION

Scratch is a project of the Lifelong Kindergarten Group at the MIT Media Lab. It is provided free of charge. With Scratch, you can program your own interactive stories, games, and animations and share your creations with others in the online community.

In this paper, a novel Scratch tutorial is designed and used to conducts a statistical analysis of students projects for this tutorial. In order to improve teaching effectiveness, the relationship between the tutorial teaching and the students' performance is studied to provide reference for designing a reasonable and standardized teaching course.

## II. TUTORIAL DESIGN

In this paper, we extend the Catch Game project in Scratch's official website. The basic requirement of this tutorial is to make a game that allows players to use a bowl to catch fallen apples from the sky. It mainly includes sprite module, background module, sensing module and control module and so on. Based on mention-above, we add data module, message module, appearance module, copy module in this tutorial. Then, the improved tutorial can count the score of caught apples and judge the program termination condition. Besides, it can send messages to other sprites and enhance the interaction between games and users. Each step in this tutorial is as shown in Table1 [3].

This tutorial includes major scripts modules of the Scratch programs. Scratches various modules can be used by students and we can record the learning process. The tutorial includes about 50 operations. Besides, the final standard program consists of 102 program blocks. In the creative process, copy the sprite to reduce the workload.

In this paper, we use Scratch Analysis Tool (SAT) as judge criteria to score projects. SAT is a new Scratch Project

TABLE I  
DESIGN OF EACH CHAPTER IN THE TUTORIAL

Chapter	Number of operations	Learning modules	Score
1-2	2	Sprite, Background	2
3-4	5	Event, Motion, Control	4
5-6	7	Operators, Control, Motion, Character	7
7	14	Sensing, Control, Motion, Event	8
8	7	Sound, Sensing, Control, Motion, Event	9
9	8	Data, Variable	10
10	10	Message, Operators, Data, Control	12
11	2	Copy, Submission	14

TABLE II  
DATA STRUCT

id	user	lesson_id	chapter_id	start_time	end_time
12	chenxiangyang	15	3	07:39:49	07:39:49

analysis tool [4]. It meets CT skills criterion based on ANTLR. Compared with other tool, SAT have better robustness and performance. Besides, it complements the evaluation criterion as well. After each chapter of this tutorial is completed, the CT scores can be obtained are also shown in Table 1 [2].

## III. DATA COLLECTION AND ANALYSIS SYSTEM

In order to analyze the relationship between students' learning process and grades quantitatively, a data collection and analysis system in the learning process is designed, as shown in Figure 1. During the students refer to tutorial, the system will record the students' time spent in each chapter so as to analyze the students' learning process and learning effects. When students enter the page of a chapter, the system records the start time; then, when students leave the page of a chapter, terminal time is recorded. The data storage format is described as Table 2 [1].

The data analysis module will score uploaded projects with SAT automatically. In this process, the total learning time spent in each chapter of the tutorial will be record to distinguish effective learning and invalid learning. In this case, we find out the impact of different learning processes on the projects scores. Generally, the student will follow the guide when they watch the tutorial. Therefore, the learning time of a chapter can be approximated as the operating time of this chapter.

**Definition 1:** Let  $t_{ijk}$  denote the time spent by  $i^{th}$  student in the chapter  $j$  of  $k_{th}$  learning,  $x_j$  is the number of operations in chapter  $j$ , then the average time that student  $i$  spends each

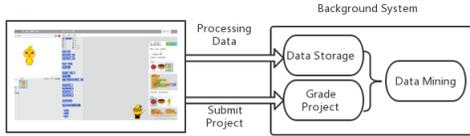


Fig. 1. The structure of data collection and analysis system step in chapter  $j$  will be

$$m_{ij} = \frac{\sum_{k=1}^n t_{ijk}}{x_j} \quad (1)$$

**Definition 2:** If  $m_{ij} \geq a_j$ , then the learning time of  $i^{th}$  student spending on the chapter  $j$  is effective, where  $m_{ij}$  is the average time of  $i^{th}$  student spending on chapter  $j$  and  $a_j$  is the threshold given by teacher.

#### IV. EXPERMENTS AND ANALYSIS

For the students in Class 603 and Class 606 of Grade 6 in the second elementary school in Yiwu, we carry out Teaching Experiment. Among these students, 11% of them have not created any projects before, 60% of them have submitted one or two projects and 27% them have submitted 3-4 projects. In the process of 20 minutes learning, 1391 learning process data was obtained. The students in Class 603 submitted 32 projects and the students in Class 606 submitted 42 projects.

##### A. Projects scores

We make statistics on the projects score in Grade 6 Class 3 and Class 6, respectively. We can find that all students (including students who have never submitted works) have achieved a 9 score or higher by using tutorial teaching. That is to say, the tutorial can help students to master the basic programming process quickly. However, the scores of students in Grade 6 Class 3 are higher than the scores of students in Grade 6 Class 6. In particular, 15.4% of students in Grade 6 Class 3 get top scores while only 2.4% of students in Grade 6 Class 6 get top scores. This indicates the existence of learning differences.

##### B. Learning process analysis

Figure 2 shows the average learning time in each chapter.

We can observe that students in both classes spend less time in the first six chapters and spend more time in last five chapters. That is to say, learning basic modules such as motion modules and control modules is faster for students. However, for other modules such as data, user interaction and message modules, students require more time to learn. For the various chapters of students in Grade 6 Class 3, we give the further analysis of the average operating time, as shown in Table 3.

It can be seen from Table 2 that the average time of these students costing for motion, sensing and control modules is about 30s, while the time costing for data and interaction modules is more than 50s. Therefore, the learning time of different modules is different.

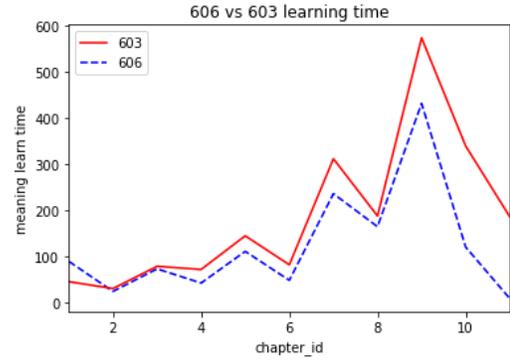


Fig. 2. The structure of data collection and analysis system

TABLE III  
VALID STUDY TIME

Chapter	3-4	5-6	7	8	9	10	11
Time(s)	32	35	23	25	70	35	100

##### C. The relationship between effective learning and grades

Based on the statistics in Table 3, all students in both classes completed effective learning in the first eight chapters when the effective learning threshold was set at 20% of the average learning time. However, in the last chapter, there were 9 students in Class 603 completing effective learning, and so on. 15.4% of students in the class get top scores. There are only 3 students in 606 completing effective learning and hence only 2.4% of students in 606 get top scores. We can observe that there is a significantly positive correlation between students' scores and effective learning.

#### V. CONCLUSION

In this paper, we proposed a moderate difficulty Scratch tutorial which covers most of the modules. Based on it, we showed experiments from two classes of students. We observe that tutorial learning can help most students quickly obtain the basic skills and the students need different time to learn different modules. Moreover, we discover that there was a significantly positive correlation between students' achievement and effective learning time.

#### VI. ACKNOWLEDGMENT

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