A study of learning motivation of senior high schools by applying unity and mblock on programming languages courses

L H PENG[1], M-H BAI[2] and I Siswanto[3]

[1] National Yunlin University of Science and Technology Department of Creative Design. University Road,Section 3,Douliou,Yunlin 64002. Taiwan.
[2] Doctoral Program, Graduate School of Design, National Yunlin University of Science and Technology. University Road,Section 3,Douliou,Yunlin 64002. Taiwan.
[3] Automotive Engineering Education Department, Faculty of Engineering, Universitas Negeri Yogyakarta. Indonesia.

E-mail: penglh@yuntech.edu.tw

Abstract. This study aims to explore whether high school students can enhance students' learning motivation through challenging learning situationsin programming courses. This study was conducted for 12th-grade students in high school. The experiment lasted for eight weeks. Measurements included Pre- and post-tests measure MSLQ (Motivated Strategies for Learning Questionnaire) and the performance of programming. The experimental group learning design the game interactive project in Unity with C# programming language, and the control group learning build Arduino interactive project in mBlock with block-based programming. The results showed that there was no significant difference in performance, but the learning motivation of the experimental group was lower than that of the control group.

1. Introduction

In recent years, Taiwan''s Ministry of Education has incorporated programming into the field of science and technology. The United States has also included programming in more than 60 schools and districts. The basic program knowledge has become a must-have for the digital age.

By changes in digital media, the resources for digital learning are gradually enriched, and the media content that students are most exposed to, has also changed from books, television, and computers in the past to digital games [1]. Students are always exposed to programming. Various types of apps and digital games.

This study hopes to build a programming learning material through the familiar and preferred media content of students, learn basic information knowledge and programming concepts, compare game development tools and building block programming tools, and the learning from different materials. Hopely the impact on learning motivation.

In view of the above discussions, the research questions to be set in this study are as follows:
(1) What is the difference in learning performance between Unity learning game programming and mBlock programming? (2) What is the difference in learning motivation between Unity learning programming and mBlock building blocks.

2. Literature review

2.1. Learning Motivation

Motivation is an intrinsic factor that motivates behavior and maintains goals, allowing individuals to be energetic and directional, and to maintain behavior or maintain activity, with intensity and direction [2, 3]. Motivation is also one of the factors that affect students' effectiveness and achievement in learning [4].

Mayer [5]'s research on learning motivation and cognitive load in multimedia learning courses found that interesting decorative illustrations that are not directly related to the course content can enhance learner participation and interest, but will make low-aware learners more It is easy to be affected by cognitive load, and challenging learning situations can enhance learners' motivation and participation.

It can be known from the above literature that combining the appropriate challenge scenarios in the curriculum can enhance the learner's motivation and participation in the learning system, thereby affecting the students' effectiveness in learning.

2.2. Problem-Based Learning

Problem-Based Learning (PBL) originated in the McMaster University School of Medicine in Canada and then evolved into other areas. Barrows and Tamblyn [6] believe that problem-oriented learning is to enable learners to learn independently through student-centered, problem-based materials, group-based, and discussion-based approaches. It also summarizes the six stages of problem-oriented learning: (1) encounter problems, (2) present problem situations, (3) assess the degree of students and the difficulty of the questions, let students try to challenge, (4) guide students through problem solving Learning knowledge, (5) solving problems through learned knowledge and skills, and assessing their learning outcomes, and (6) integrating and summarizing old knowledge.

Hsu and Lin [7] incorporate PBL in the university's programming curriculum. In addition to facilitating learners' knowledge internalization and self-learning, the curriculum has also proven to be effective in programming courses.

Based on the characteristics mentioned in the above literature, this study integrates the problem-oriented learning concept into the design content of the curriculum, allowing students to learn programming in a stable teaching model.

3. Method

3.1. Research Structure

The purpose of this study is to experimentally incorporate challenging learning situations and content into high school programming courses to assess whether learners' learning outcomes and motivations can be improved, and to use of MSLQ learning motivation and strategy questionnaires. Volume, research architecture as shown inFigure 1.

The experiment divided the subjects into experimental group and control group. Both groups passed the problem-oriented learning design course content and received the programming course of the same teacher. The course time was eight weeks and two classes per week. During the experiment, the experimental group used Unity for game programming learning and operation; the control group used mBlock computer software to operate the building block program with physical electronic components for programming learning and operation.
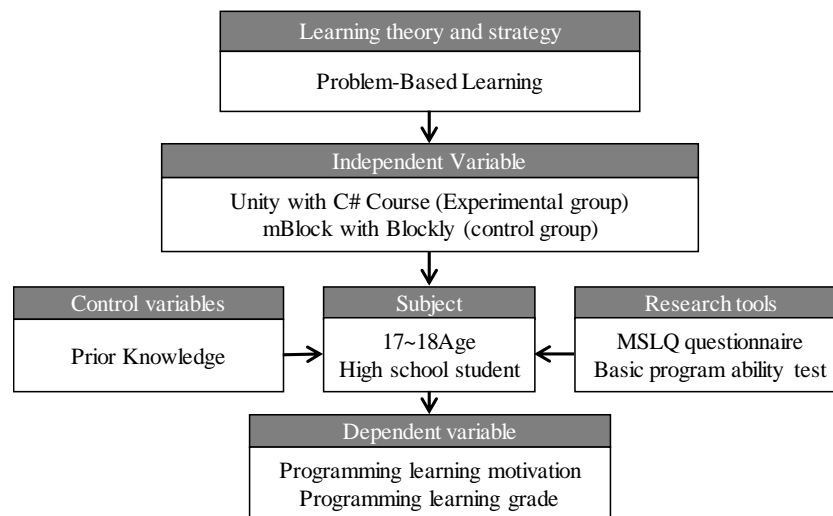
Figure 1. Conceptual framework

3.2. Research Process

The experiment lasted for eight weeks. Through the experimental process of Figure 2, the MSLQ learning motivation and strategy questionnaire and the basic program ability experience questionnaire were used for pre-testing. According to the experimental group and the control group, experiments were conducted in different teaching modes. After the experiment, MSLQ learning motivation was used. Post-test with the strategy questionnaire and the basic program ability questionnaire.
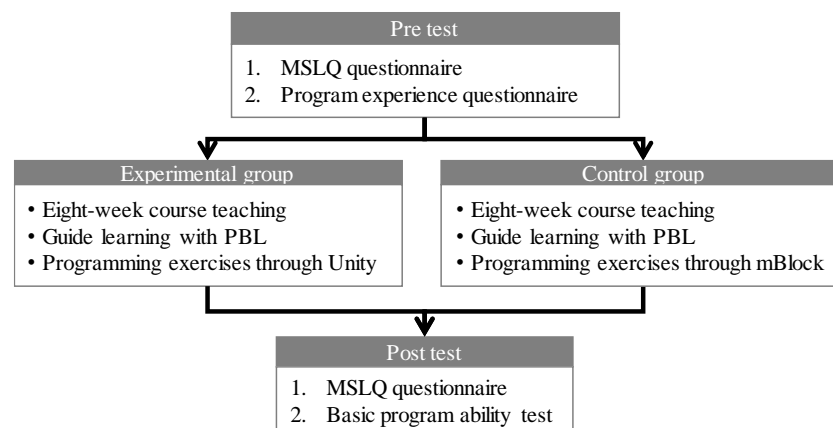

Figure 2. The experiment process.

3.3. Research tools

3.3.1. Motivated Strategies for Learning Questionnaire

The Motivated Strategies for Learning Questionnaire is used to measure the motivation of the subject. The Learning Motivation and Strategy Questionnaire was designed by Pintrich and De Groot [8] for the six projects of Intrinsic Goal Orientation, Extrinsic Goal Orientation, Task Value, Control of Learning Beliefs, Self-Efficacy for Learning and Performance, and the Test Anxiety Measurement.

3.3.2. Program experience and ability questionnaire

This questionnaire is a self-made questionnaire for researchers. It mainly understands the subject's prior knowledge of the program and the basic ability of the program. The multiple-choice questions

are designed in the test questions to test the basic concepts of the program. The objective is to obtain quantitative data through questionnaire results to assess the learning outcomes of the subjects.

3.4.Course Design
This study focuses on different programming learning courses, learning outcomes and motivational differences in learning the same programming concepts.

The content of the course and the teaching focus of the experimental group and the control group are the same.

The experimental group used the Unity with the C# programming language to design and learn the game program. The control group uses the mBlock with the Arduino physical components, and the student needs to use mBlock to build a block program to design and learn the program.

4. Result and discussion
There were 71 subjects, 35 students were in the experimental group, and 36 students were in the control group.

The MSLQ consisted of 31 items. The Cronbach's alphas for the 31 items were .943, respectively. The stress inventory was found to be highly reliable.

4.1.Analysis of learning efficacy
Levene's test was found to the homogeneity of variance assumption has been violated. Therefore, we try to data transformation with the square root in course grades. The homogeneity of variance assumption has been observance after data transformation.

There performed one-way ANCOVA to learning efficacy as Table 1 and Table 2. The results show no significant difference exists after excluding programming experience in the two groups of students' learning efficacy(F (1, 68)=2.528, p =.116, η_p^2=.036).

Table 1. ANCOVAwithFinal Course Score

Source	SS	df	MS	F	p	η_p^2
Score*Group	1.935	1	1.935	2.528	.116	.036
Error	52.057	68	.766			

Note.[e]n = 35, [c]n = 36.

Table 2. Descriptive Statistics withFinal Course Score

	Experimental group(N=35)	Control group(N=36)
	M(SD)	M(SD)
Course Score	7.255(0.718)	7.555(1.003)

The statistical results show that high school students learn to program from Unity or mBlock after excluding programming experience in the programming course and there is no significant difference in learning efficacy.

4.2.Analysis of learning motivation
Levene's test was found to partial data the homogeneity of variance assumption has been violated. Therefore, we try to data transformation with the multiplicative inverse in internal goal orientation, task value, and self-efficacy for learning and performance. The homogeneity of variance assumption has been observance after data transformation.

There performed one-way ANCOVA to MSLQ questionnaires as Table 3and Table 4. The results show no significant difference in Extrinsic Goal Orientation (F(1, 68)=.01, p=.91, ηp2<=.00), Control of Learning Beliefs (F(1, 68)=1.49, p=.23, ηp2=.02) and Test Anxiety (F(1, 68)=3.82﹐p=.06, ηp2=.05) exists after excluding programming experience.

There was a significant difference of Intrinsic Goal Orientation ($F(1, 68)=5.96$, p=.02, ηp2=.08), Task Value ($F(1, 68)=4.17$, p=.04, ηp2=.06) and Self-Efficacy for Learning and Performance ($F(1, 68)=4.33$, p=.04, ηp2=.06).

The Intrinsic Goal Orientation of the experimental group (M = 3.41, SD = 0.73) was significantly smaller than that of the control group (M = 3.79, SD = 0.68), and the experimental group's Task Value (M = 3.40, SD = 0.70) was significantly smaller than the control group (M = 3.69, SD = 0.67), the Control of Learning Beliefs of the experimental group (M = 3.69, SD = 0.57) were significantly smaller than the control group (M = 3.90, SD = 0.57).

Table 3. ANCOVA with MSLQ

Source	SS	df	MS	F	p	η_p^2
Intrinsic Goal Orientation*Group	0.01	1	0.01	5.96	0.02	0.08
Error	0.11	68	0.00			
Extrinsic Goal Orientation*Group	0.00	1	0.00	0.01	0.91	0.00
Error	20.93	68	0.31			
Task Value*Group	0.02	1	0.02	4.17	0.04	0.06
Error	0.30	68	0.00			
Control of Learning Beliefs*Group	1.35	1	1.35	4.33	0.04	0.06
Error	21.21	68	0.31			
Self-Efficacy for Learning and Performance*Group	0.01	1	0.01	1.49	0.23	0.02
Error	0.61	68	0.01			
Test Anxiety*Group	0.90	1	0.90	3.82	0.06	0.05
Error	16.04	68	0.24			

Note. [e]n = 35, [c]n = 36.

Table 4. Descriptive Statistics with MSLQ

	Experimental group(N=35) M(SD)	Control group(N=36) M(SD)
Intrinsic Goal Orientation*	3.41(0.73)	3.79(0.68)
Extrinsic Goal Orientation	3.81(0.51)	3.78(0.60)
Task Value*	3.40(0.70)	3.69(0.67)
Control of Learning Beliefs*	3.69(0.57)	3.90(0.57)
Self-Efficacy for Learning and Performance	3.44(0.64)	3.58(0.70)
Test Anxiety	3.81(0.58)	3.92(0.51)

Note. * $p < .05$

The statistical results show that high school students learn to program from Unity or mBlock after excluding program learning experience in programming courses. There are significant differences in some learning motivation factors.

When high school students use Unity or mBlock to learn to program, there is no significant difference between Extrinsic Goal Orientation, Self-Efficacy for Learning and Performance, and Test Anxiety.

However, the Intrinsic Goal Orientation, Task Value, and Control of Learning Beliefs, which are motivated to learn, are significantly lower than those who use the mBlock learn to program.

5. Conclusion

This study is expectedto explore the differences between students' learning outcomes and learning motivations through challenging programming content. Therefore, Unity works with C# and mBlock

with modular building blocks to conduct programming courses and pass the course before the course. Questionnaires were used to understand whether students have experience in programming learning. After the course, MSLQ and Proficiency Test will be used to understand students' motivation and learning effectiveness.

From the analysis results of 4.1, students can learn programming in two different ways, and there is no significant difference in learning outcomes. It can be seen from the same programming concept that students do not influence students' understanding of program concepts because of C# or building block programs. Therefore, exploring how to make students motivated to learn should be an important topic in the programming curriculum.

From the analysis results of 4.2, it can be known that when students learn C# through Unity, there are some significant differences in learning motivation, which is lower than using mBlock with building blocks. It can be seen that when high school students learn programming, Unity and C# cannot stimulate students' learning motivation. Although it does not affect the learning outcome, students prefer mBlock to Arduino's teaching mode. Therefore, in the programming course of study, the degree of acceptance of the teaching medium should be considered, and the students are more accepting of the intuitive programming tools.

This study attempts to explore the differences in learning outcomes and motivation between students through more challenging programming of course content. However, when high school students use different programming tools to learn programming, it does not affect the learning outcomes. However, the cumbersome programming tools reduce the motivation of learning for high school students. Although Unity and C# are currently common tools in games and interactive design, their interface and operation are worthy of discussion for high school students who are new to programming. The intuitive design of mBlock's building block program makes high school students' learning motivation relatively high.

Although the basic concept of programming is an important part of today's education, this study explores the relationship between learning outcomes and learning motivation through different teaching tools. Perhaps future research can try to explore how students can improve their learning motivation through better curriculum design when learning programming, or whether there are other factors that influence students' acceptance of programming courses. 。

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