A Comparative Study of Different App Development Courses with a Case on Learning Satisfaction and Creativity

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Abstract
Program development is a practical course in higher education. Nowadays, there is a diverse selection of mobile app development software platforms. In terms of app development for Android, common tools include Android Studio and MIT App Inventor. However, these tools have different difficulty levels in learning. In this study, we use these two tools in teaching separate groups to investigate how students perform in creativity and learning satisfaction after course completion and examine whether there will varying effects on the intentions of continuous mobile app development learning. Using the partial least squares analysis method, this study conducts surveys of students from a university in Central Taiwan through the purposive sampling method. The analysis results show that different tools generate inconsistent effects on the intentions of continuous learning in terms of creativity. On the other hand, significant effects are observed in terms of learning satisfaction. App Inventor is indeed easier to use than Android Studio and hence users show greater interests in learning.

Keywords: Mobile application (APP), creativity, satisfaction, programming, android studio, MIT app inventor

1. Introduction

The year 2020 has seen a wave of 5G commercialization across the world, which has brought about the rapid development of a new generation of mobile app systems. In fact, mobile app development had thrived since the 3G era and matured in the 4G era. By that time, it had started integrating financial payment systems, GPS, video applications, and various other products. Among them, mobile game app development displayed the greatest diversity and number. With increasingly diversified products, smartphone developers have gone from simple operating systems and database connections to more and more complex software programs, which include gyroscopes, open data, artificial intelligence, and other information engineer technologies. Accordingly, app developers need to equip themselves with a wider range of professional knowledge. Although there seems to be a buoyant demand for app developers, it is not easy to find all-round developers who are able to create mobile apps for enterprises.

According to Liu et al. (2014) research, mobile app development will remain an in-demand job for decades to come. However, in reality, not all mobile app developers can meet the expectations and needs of companies. Actually, mobile app development tools on the current market involve a steep learning curve. A mobile app developer needs to invest a considerable amount of time in learning and research before developing a stable and mature product (Bresnahan et al., 2014; Joorabchi et al., 2013). There are two main reasons for the steep learning curve. First, in terms of mobile phone operating systems, there are two major players: Apple's iOS (Programing language: Swift) and Google's Android (Programing language: JAVA, Kotlin), which account for more than 90% of the global market share. App developers need to choose one programming language to learn. However, these two operating systems use different programming languages for their mainstream app development tools. Although some app-editors on the market are advertised as providing compatibility, allowing app developers to create cross-platform systems by using only one language and one tool. Yet, the results are not as stable as native apps (Biørn-Hansen et al., 2019).

Secondly, the current framework for integrated development environments (IDE) is rather complicated. There are too many technical terms for interfaces and operation. Also, operating systems (OS) are constantly updated. App developers have no choice but to spend huge amounts of time learning version management, collaborative update, and other sophisticated professional knowledge about the environment and system. This results in its steep learning curve (Song et al., 2013). Therefore, it is indeed quite challenging for college instructors to cover all professional areas within an 18-week course.

One famous and simple app development tool for Android OS is App Inventor. It is currently maintained by Massachusetts Institute of Technology (MIT). MIT helps promote the product and further authorizes other new ventures to develop similar products (e.g. Power APP). As the app inventor is a visual, blocks-based tool for app design, it is quite simple to learn, hence enjoying higher levels of acceptance among students (Mikolajczyk et al., 2018). In fact, many elementary and middle schools have adopted the app inventor as a tool in programming language teaching. Edwards et al. (2014) point out that a simple and user-friendly learning tool will facilitate fun programming experiences. On the other hand, as Google is promoting Android app development, they offer app developers a free Google-maintained tool – Android Studio. Different from app inventor, Android Studio is a large-scale IDE that offers comprehensive functions. The core of the program is modified based on IntelliJ IIDEA. Currently, mobile app development is included in all university/college curriculums. Tool selection for the course is a topic worth studying – specifically, whether the choice between these two tools will produce different levels of learning satisfaction and creativity among students after course completion and further affect their intentions of continuous learning in the future. In this study, we will investigate two separate groups of university students, for whom app inventor and android studio are used as instructional tools respectively, and examine their learning results through questionnaire surveys.

2. Literature Review and Hypotheses

2.1 App Inventor and Android Studio

Android Studio is an integrated development environment for Android operation system. It was announced on May 16, 2013 on Google, available to app developers for free download. The first stable build was released in December 2014, starting from version 1.0. Android Studio is built on JetBrains' IntelliJ IDEA software. It supports the Java programming language. It is installed on client and can be run on MS-Windows, macOS, and Linux.

App Inventor is also Google's app development software. It was publicly announced in December 2010 and is now maintained and operated by the MIT. As App Inventor is run in a cloud environment, users need to sign into their Google accounts. It uses a graphical user interface (GUI) like the programming language Scratch and StarLogo TNG, which allows users with or without knowledge of programming languages to design apps using the visual interface. A rudimentary comparison is summarized in Table 1.

Table 1: Compared of Android Studio and App Inventor

	Android Studio	App Inventor
Programing language	JAVA, Kotlin	Graph, component
Cost	Free	Free
Operation interface	Difficult	Easy
Install size	871MB or more	None
Mobile simulator	Android virtual device	None
Database support	High-availability	Depend on component

Source: this study

2.2 Creativity

Educational research usually involves the creativity of students. Published in 1999, the National Advisory Committee on Creative and Cultural Education (NACCCE, 1999) described the term democratic creativity, that is, students can creatively produce valuable and original results. A number of studies explored the impact of creativity on students in the field of education as well as how to cultivate and improve student creativity. Physical environment, learner engagement, and class climate support student creativity (Richardson & Mishra, 2018). Matraeva et al. (2020) argued that students' creativity depends on their ability to participate in the course. Lutfiani's (2021) showed that creativity affects students' learning interest and performance in the class. In summary, the creativity of students is considered one of the outputs of education. If students express creativity in the classroom, it means that the course is valuable and reflects effective learning.

Creativity decides how people present their creative ideas. There are numerous factors that affect creativity, which include personal background and experience (Kaufman et al., 2008). Some studies have also proven that creativity will be limited by available resources and the quality of the resources (Barbot et al. 2011; Thorsteinsson & Page, 2007). In other words, a good tool should not only prove useful but also offer users a development environment that facilitates resource applications. For computer program development tools, ideal IDEs should cater to users from different backgrounds by offering user-friendly operation interfaces. This will enable all levels of users to freely unleash their creativity. With positive user experience, users will be more willing to continue learning. We hypothesize the following connection.

Hypothesis 1: Student creativity will positively affect continuous APP learning intention.

2.3 Learning Satisfaction

Learning satisfaction measures the levels of students' satisfaction with the overall learning process (Ke & Kwak, 2013). Tadesse et al. (2020) pointed out that if students are more interactive and task-oriented in the learning process, they will be more satisfied with their learning. The degree of satisfaction is related to personal experience and background (Marton & Säljö, 1997). Students who have previously encountered a certain course or content may consider it uninteresting, whereas others may feel that the course or content is a new thing, so their level of satisfaction is higher (Guolla, 1999). Moreover, a number of schools use student satisfaction as a parameter for evaluating teachers' performances. However, several scholars argue that education and learning have a certain degree of difficulty, and student learning satisfaction is not a suitable parameter in assessing the quality of teachers (Bedggood & Donovan, 2012). Moreover, it cannot directly reflect learning performance and self-efficacy, many studies have shown that students with higher levels of learning satisfaction also display better learning performance and self-efficacy, as well as positive intentions of continuous learning (Hong et al. 2016; Shen et al. 2013). We thus hypothesize the connection.

Hypothesis 2: Learning satisfaction will positively affect continuous APP learning intention.

Based on Section 2 above, Figure 1 depicts this research proposed model.

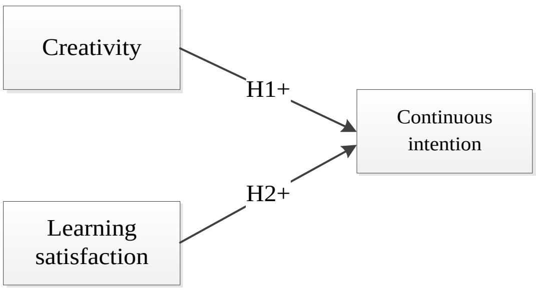

Figure 1: Proposed Hypothesis Model

3. Research Method

This study aims to explore the effect of two different learning tools on the learning satisfaction and creativity of students, and further examine the influence of these two factors on the intention of continuous learning. Our research subjects were from two classes of a university in Central Taiwan. The two classes learned the same topic – mobile programming – using different tools. The class using App Inventor was defined as Group A while the class using Android Studio was defined as Group B. A total of 31 valid questionnaires were collected from Group A and 43 from Group B. All subjects were students aged between 19 and 23, which indicated no significant age difference. Group A was composed of 26 males and 5 females, while Group B consisted of 34 males and 9 females. Overall, male samples outnumbered female samples. This student structure shows that programming design is still the most of the male.

In this study, we used SmartPLS analysis tools and designed our survey questions based on previous literature. For learning satisfaction surveys, we referred to Orús et al. (2016). As for creativity surveys, various scales have been proposed in previous studies, with disparate research focuses and varying question numbers (Barbot et al., 2015; Lubart et al., 2013). In this study, we adopted the scale of Kumar et al. (1991). As Kumar et al. (1991) surveyed the creativity of college students, their questions are suitable for our survey. In terms of the intentions of continuous learning, we referred to the research of Sørebø et al. (2009), with reverse questions removed, and some wording adjusted. All questions were answered on the 5-Point Likert Scale, with 5 indicating "completely agree" and 1 indicating "completely disagree," to reflect the perception of the subjects. As both groups had a small sample size, calculations were conducted using the simulation method, with bootstrap replication set at 5,000.

4. Statistics Result

For research reliability analysis, we test composite reliability. According to Hair et al. (2014), for higher reliability, factor loadings should be greater than 0.7 (Table 2), AVE values higher than 0.5 on the convergent validity parameter, and the inter-construct correlation coefficient lower than the square root of AVE (Fornell & Larcker, 1981; Gaski & Nevin, 1985). This study meets all thresholds, as shown in Table 3.

Table 2: Descriptive Statistics and Standardized Loadings of Items

Items		*N*	Mean	Std. Dev.	Factor Loading
	Creativity (CR)				
CR1	I can develop my creativity in this class.	31	4.09	0.77	0.884
		43	4.42	0.78	0.874
CR2	I display creative results in this class on a regular basis.	31	4.45	0.61	0.857
		43	4.47	0.62	0.905
	Learning satisfaction (SAT)				
SAT1	I am satisfied with the studying tool applied in this course.	31	4.58	0.61	0.916
		43	4.51	0.62	0.927
SAT2	I am satisfied with the knowledge (skills) I have acquired in this	31	4.65	0.54	0.937
	course.	43	4.56	0.58	0.936
SAT3	The experience I have had in this course has been satisfactory.	31	4.64	0.48	0.897
		43	4.65	0.47	0.878
	Continuous intention (CI)				
CI1	I think I will continue to learn mobile app development related	31	3.87	0.66	0.884

Items		*N*	Mean	Std. Dev.	Factor Loading
	technologies in the next three months.	43	3.84	0.64	0.935
CI2	I will continue using this tool to learn knowledge and techniques	31	4.58	0.71	0.857
	related to mobile applications.	43	4.51	0.79	0.941

Table 3: Correlation Matrix

Construct	CR	AVE	Correlation Matrix		
			CR	SAT	CI
Group A					
Creativity	0.862	0.758	1		
Learning satisfaction	0.941	0.841	0.803	1	
Continuous intention	0.923	0.856	0.839	0.916	1
Group B					
Creativity	0.889	0.800	1		
Learning satisfaction	0.938	0.835	0.813	1	
Continuous intention	0.936	0.879	0.802	0.897	1

The results of hypothesis testing based on the two groups are summarized in Table 4. In terms of hypothesis testing, the first hypothesis proved valid for Group A but failed to achieve a high level of significance for Group B.

In terms of research results, we have demonstrated that creativity does have a positive effect on the intentions of continuous learning. Students' creativity should be promoted in the teaching of courses. We suggest that students need to have more programming exercises in class, and teachers should promote an environment where students work with each other, such that they can perceive the creativity of others and improve their own abilities. Yet, the lower significance level for Group B (who used Android Studio) indicates that students who use App Inventor could develop their creativity more easily. As for the second hypothesis, it held valid for both groups. Higher levels of learning satisfaction entail greater intentions of continuous learning. This finding corresponds to previous research results.

Table 4: Hypothetical Results

Relationship	Path coefficient	t-value
Group A		
H1:CR → CI	0.371**	2.298
H2:SAT → CI	0.591***	3.847
Group B		
H1:CR → CI	0.215*	1.750
H2:SAT → CI	0.723***	6.580

*** $p < 0.01$. ** $p < 0.05$. * $p < 0.1$.

5. Conclusion

This study explores the intentions of continuous learning in terms of creativity and learning satisfaction and tries to understand the differences between these two learning tools - App Inventor and Android Studio. Although both groups of students demonstrated intentions of continuous learning, the group using App Inventor displayed higher levels of learning satisfaction and creativity development. In this study, we simply proposed an analysis framework. We did not delve further into other behavior theories. Discussion on factors involved in various dimensions was also limited to a few theoretical descriptions. Therefore, it is necessary to conduct further research on the depth and verifiability of this model.

Popat and Starkey (2019) point out that many studies today overlook the steep learning curve associated with programs and tools. They merely explore the usefulness and ease of use of learning tools. Although IDEs are useful, it is necessary to observe the levels of learning satisfaction and creativity among users in terms of program learning and IDE operation, for a better understanding of their true perception. This study has provided a supplement to this commonly overlooked area. We suggest a sensible research priority - that is, researchers should examine the difficulty level of learning tools before conducting further investigations on learning performance. This serves as the main contribution of this research.

In terms of research limitations, given that this study was conducted on the basis of two classes of students in a school, it showed lower statistical reliability and validity with small sample size. However, we consider that the study results have effectively reflected the obstacles currently experienced in learning app development. Secondly, the literature review is rarely discussed in education papers. In addition, the research result did not further test the two groups' differences, and some student's backgrounds (e.g. experience and characteristics) may interfere with accurate results.

However, the internal validity of such methods may still have flaws. Thirdly, in this study, the use of different IDEs was a control variable. We did not include tool types in our hypotheses. Instead, we focused on learning satisfaction and creativity shown after course completion. In future research, we may further explore the effect of different tool types along with the usability of these tools.

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