The development of textbooks for mobile application programming

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Abstract. Learning mobile programming has become more popular since advance in technology makes mobile phone more critical for every person. Meanwhile, the independence of student in learning the course is essential regarding the learning independence might make students more successful in learning. This study aims to develop and produce a book that will be used as a source in Mobile Programming Course. The four-step development model by Thiagarajan, Semmel, & Semmel was used as a development framework. The result shows that the book has passed all the development stage successfully which means that the book is ready to be used in the course.

1. Introduction
Nowadays, the mobile phone becomes more critical and popular. Instead of using a mobile phone only for communication, many people use it for some functions: taking pictures, do some calculations, noting the agenda using calendars, even to do regular works like opening and sending emails. The result of the popularity is the significant increase in mobile phone’s hardware and software development as well as operating systems: Blackberry, Windows Phone, IOS, and Android to name but a few.

Android is the most popular smartphones’ operating system since it has the highest market share, especially in Indonesia [1] which means that the most of mobile phone users are the users of Android device. This platform, which was primarily developed by Andy Rubin, has been developed by Google and the Open Handset Alliance with the Android Open Source Project (AOSP) [2–4]. Android is the best-selling operating system in the world for smartphone category. More than 300 million devices use this OS, and 850 thousand new devices are activated every day [2]. There was much previous research on Android and its development by several researchers due to its rapid development [5–14]. This massive number of Android users implies more opportunity for the software developer to create a new mobile application in Android platform.

Moreover, the mobile application is a computer program which is invented to perform on mobile devices; phones, tablets, watches, to name but a few. In modern information and communication use, a mobile app is one of the most concerned and rapidly developing areas. There is a positive input of mobile application [15], and the usefulness of the mobile application has been researched by some expert [16,17].

The number of applications that are available in Google Play store has reached 3.8 million apps, and it becomes the highest number of application available for mobile phone’s operating system [18].
of the applications that are available in the Google Play store are used for education purpose. Meanwhile, the use of mobile applications to support learning has been investigated by some researchers (see [19–22]).

Developing mobile application means do programming activity to produce applications. To develop a mobile application, a programmer has several programming tools to use. One of the mobile programming tools is App Inventor. Google promoted app Inventor as an open source web application and controlled by Massachusetts Institute of Technology (MIT). App Inventor allows people with no programming experience to create applications on the Android platform. Programming using App Inventor is coding-less since it based on visual block programming that can create applications without using any line of code. App Inventor is designed using a graphical interface, which allows users to drag and drop the blocks, which contain command and specific event handler, in creating applications. There are several benefits of using App Inventor such as its practicality and simplicity. However, the web application still has several drawbacks, and its main drawback is that some components which are essential to be used in programming are incomplete. Thus, if programmers want to make a complex program, it is better for them to use other development application like Eclipse (see [23]).

App Inventor gives access to users with no previous programming experience to create applications for phones which use the Android operating system. App Inventor gives a new perspective in programming due to its ability to make a program with visual block programming instead of lines of code. The widespread of App Inventor for developing Android applications made several researchers were interested in studying it [24–26].

A study by Shih et al. [27] showed that the MIT App Inventor makes mobile application development highly visual and intuitive. It also could engage students in developing not only useful applications but also logical thinking skills, problem-solving techniques, and creativities. Other research found that applications development process using App Inventor as a prototyping method is more efficient compared to Software Development Kit (SDK) only [28]. However, another research said that App Inventor is useless for professional but useful for a non-IT specialist for creating personal application [29]. Concerning educational purpose, many people have used App Inventor for educational purposes and found that App Inventor is beneficial for educational purposes (see [20–22]). Since the benefit, App Inventor has been used as the primary development tool in Mobile Programming course at a university in Semarang.

Furthermore, students who learn Mobile Programming course in higher education need to be more independent in their study. There are several ways to describe the term of independent learning. Sometimes the term refers to “ownership of learning,” “self-directed learning” or “learning how to learn” [30]. Independence learning is a learning activity carried out by students without relying on help from other people, both friends, and teachers, in achieving learning goals. The learning goals that have been mentioned are mastering knowledge using their awareness and applying the knowledge in solving problems [31]. Meanwhile, it is believed that learning should be able to provide a condition that can make students build their concept [32]. This condition requires students’ independence that intentionally familiarized in daily learning activities.

Independent learning can train students to be more responsible and independent on others. It also fosters students’ self-confidence to make them receiving and understanding the subject matter more easily. Furthermore, in the context of higher education, the independence of students in learning generally refers to the responsibility of the student to direct and regulate their learning process [33]. Desmita [34] said that there are several indicators of independent learning: (a) there is a desire of the students to learn, (b) the students can make decisions and initiatives to deal with problems, and (3) students have responsibility for what he did. Several previous research on independent learning have been carried out by several experts. Morris [35] identified factors which obstruct the independent learning of first-year students of engineering. Field et al. [36] studied independent learning using Self-Determination Theory (SDT) as the theoretical bridge while Broad [37] studied the interpretations of learning independent of students and explained the reasons for the interpretations that exist in academic and vocational students.
This study aims to develop a book of Mobile Programming course which uses App Inventor as main development software. The main reason for developing book is students need a reference book that contains the course material that can be easily understood by students and can be used for independent learning. The design of the book intentionally gives more chance for students to learn independently and explore the course topics by themselves. The book is also designed to make students can follow the central concept of the development of Android applications and apply it to produce applications in various fields.

2. Methods
This research, which developed a textbook, was development research which used four steps developed by S. Thiaagarajan, Dorothy S. Semmel, dan Melvyn I. Semmel. The steps are (1) define that contains of front-end analysis, student analysis, concept analysis, task analysis, and formulation of objectives; (2) design that consists of format selection and preliminary design; (3) development that consists of evaluators’ assessment, readability test, and limited trials; and (4) disseminate that produce the textbook. In this research, the steps were limited only until the third stage (the development stage). The research was conducted in the Department of Mathematics in a university in Semarang on March until September 2018. The second-year students of the mathematics education program were determined as the subjects that were chosen purposively. Collection of data was conducted using two non-test instruments: validation by expert and user questionnaire. A validation sheet was used to obtain expert assessment about the content of the book, and a questionnaire was used to measure the opinions of a group of students about the book.

3. Results and discussion

3.1. Define stage
The first step of this research was defined which contains front-end analysis, student analysis, material analysis, task analysis and specifying learning objectives. In the front-end analysis, the researchers were studying curriculum, collecting supported learning theory that appropriates the use of the book in learning, and making a blueprint of book that can be used for supporting learning independently. Meanwhile, in the student analysis, the researchers were studying the students’ characteristic to decide the design of the textbook. A material analysis had been conducted to identify the material; which parts should be the main part, and that would be taught and the sequence of the material. In this stage the researchers including materials such as how to make simple applications like messenger, music and video player; and how to use a specific part of a smartphone such as camera, gyroscope sensor, and GPS. The task analysis, which covered the design of tasks given in the learning process, then had been conducted before the researchers did the last step in define which was specifying the learning objectives. This last step aimed to converse the concept and task analysis to be learning objectives (competency standard, basic competency, and competency achievement indicator).

3.2. Design
In this stage, the researchers design the book based on the results of the define stage including the competency standards, basic competencies, achievement indicator, and learning objectives of the Mobile Programming course. The Mobile Programming course uses App Inventor as main development web; thus the book is designed to support the use of App Inventor in the course. The book was designed to be organized into 18 chapters; each chapter of which consists of the main material description, example, and exercise. In the description, there is a brief description and explanation about the material. The example contains steps how to create a program from scratch. Furthermore, the exercise contains of a challenging exercise that can improve the students’ independence.
3.3. Development

3.3.1. The result of the validity test

The development stage contains a validation by some experts which is about the validity of the book’s content; whether it is related to the competency standard of the subject or not. Two experts in computer programming check the validity of the book by checking 16 aspects that were observed on the content validity including curriculum, concept, example, exercise, language, font, table, figure, and display. The result of validation then was analyzed using nonparametric statistical analysis. The researchers used the Mann Whitney U test to know that the two experts had the same decision about the content of the book. The result of the Mann Whitney U test which is illustrated in Table 1 shows that statistical value is 60 with Asymp. Sig is 0.514. It means that those two experts had the same consideration about the content of the book.

Table 1. Statistics test of validation judgement

| Statistics         | value   |
|--------------------|---------|
| Mann-Whitney U     | 60.000  |
| Wilcoxon W         | 138.000 |
| Z                  | -1.446  |
| Asymp. Sig. (2-tailed) | .148  |
| Exact Sig. [2*(1-tailed Sig.)] | .514* |

Since the book got a good result in the validity test and all two experts have the same consideration, it can be concluded that the book is valid and can be used as a learning material. However, there were some suggestions given by two experts: (1) the composition and the sequence of the contents should follow the formal guidelines of “textbooks”; (2) the sequence of contents in the book should match the order of material listed in the syllabi; (3) the book should contain exercise and evaluation at the end of each section to lead students to work independently; and (4) the layout of the book should be edited to make it more interesting. These suggestions then were used to improve the book.

3.3.2. The result of the readability test

After the book had been stated as valid by the experts, it was tested in term of its readability using small sample; whether the book is readable or not. The researchers chose five students who had joined Computer Programming course to give assessments about the readability of the book. Some of the readability indicators were language, typography, grammar, writing style, writing error, and graphics. The score for each indicator was in interval 1-5 while the score was an integer.

The result of the test was as follows. The five students gave 4-5 scores for each indicator. Most of the indicators were got a maximum score while some indicators which were related to the graphic aspects got the high score. It can be said that the developed book had reached the readability criteria. However, there are some suggestions given by the students for the book: (1) it is essential to pay attention to the width of space of the book, (2) some terms in the book tend to need to be clarified. The book then needs some revisions before it can be used in the trial stage.

3.3.3. The result of the book trial

The last stage of book’s development was a limited trial. In this stage, the researchers took a small class as sample and ask their judgment about the book. A class of second-year Mathematics Education was chosen as a sample class. There were 35 students in this class which consisted of 24 female students and 11 male students. The book then be sent for trial in the class of Computer Programming, the last meeting of which was the opportunity for the students to answer a questionnaire about the aspect of the book’s practicality and its ability to improve students’ independent learning. The results of this stage are in Table 2.
According to Widiyoko [38], a researcher can make a good classification with a comparison to the ideal mean score (\( \bar{X} \)) and the ideal standard deviation score (\( SD_i \)). The classification divided into five categories: very good, good, fair, poor, and very poor. In the user perception term, the researchers used a 1-5 scale while in the learning independence, the researchers use the same classification in the interval of 1 to 4. The classification that was used in the research can be seen in Table 3 and Table 4.

| Table 2. User Perception of Textbook |
|--------------------------------------|
| Aspect                        | Mean Score | Category   |
|-------------------------------|------------|------------|
| Practicality                  |            |            |
| Effectivity                   | 3.7        | Good       |
| Motivation to learn           | 3.9        | Good       |
| Student learning activities   | 4.0        | Good       |
| Independence Learning         |            |            |
| Responsibility                | 3.1        | Good       |
| Initiative                   | 3.3        | Good       |
| Independence                 | 3.4        | Very Good  |

| Table 3. Classification category for user perception |
|-----------------------------------------------------|
| Score Range                                      | Average Score | Category       |
|--------------------------------------------------|----------------|----------------|
| \( \bar{X} > X_i + 1.8SD_i \)                    | \( \bar{X} > 4.2 \) | Very Good      |
| \( X_i + 0.6SD_i < \bar{X} \leq X_i + 1.8SD_i \) | 3.4 < \( \bar{X} \) ≤ 4.2 | Good          |
| \( X_i - 0.6SD_i \leq \bar{X} < X_i + 0.6SD_i \) | 2.6 < \( \bar{X} \) < 3.4 | Good Enough / Fair |
| \( X_i - 1.8SD_i < \bar{X} \leq X_i - 0.6SD_i \) | 1.8 < \( \bar{X} \) ≤ 2.6 | Poor          |
| \( \bar{X} \leq X_i - 1.8SD_i \)                 | \( \bar{X} \leq 1.8 \) | Very Poor      |

| Table 4. Classification category for learning independence |
|------------------------------------------------------------|
| Score Range                                               | Average Score | Category       |
|-----------------------------------------------------------|---------------|----------------|
| \( \bar{X} \geq X_i + 1.8SD_i \)                         | \( \bar{X} \geq 3.4 \) | Very Good      |
| \( X_i + 0.6SD_i \leq \bar{X} < X_i + 1.8SD_i \)         | 2.8 < \( \bar{X} \) < 3.4 | Good          |
| \( X_i - 1.8SD_i \leq \bar{X} < X_i + 0.6SD_i \)         | 1.6 < \( \bar{X} \) < 2.8 | Poor          |
| \( \bar{X} < X_i - 1.8SD_i \)                            | \( \bar{X} < 1.6 \) | Very Poor      |

The book got a score of 3.7, 3.9, and 4.0 for an aspect of effectivity, learning motivation, and students’ activities respectively. As Widiyoko [38] said about the classification, the score can be categorised as “good.” This result illustrates that the book has a good aspect of practicality which means that the book can be used in the class as one of the learning resources. In the aspect of learning independence, the book got good predicate for the aspect of responsibility (3.1), initiative (3.3), and independence (3.4). The result means that the book can help students to learn independently.

The result of development stage illustrates that the book has passed the validity test, the readability test, and the book trial stage. Although in the validity test the experts said that the book needs to be revised, they considered that the book could be used as a learning material. Meanwhile, in the readability test, the students said that the book has a good score in all aspects and the book also got “good” and “very good” criteria in the book trial. Furthermore, based on these results, it can be concluded that the book has passed all of the development processes.

4. Conclusion
The result shows that the book that has been developed can be stated as valid due to validation from experts. It also met the readability criteria which means that the book is ready to be used in the course. The result of the trial of the book also gives information that the book can be used as learning material and it also can help students to learn independently. However, developing a book is only a starting point to design a proper learning environment that can make students learn independently. Furthermore, it is
crucial to expand the result of this research by creating a valid and reliable evaluation tool to assess students’ ability after using the book. Another future research is about analyzing the students’ respond after using the book and do an experiment that can measure the book effectiveness.

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