A Test Method for Instructional Software of Evaluation and Exercise Based on Mobile Platform

Jiujiu Yu*, Jishan Zhang, Yun Chen, Ning Wu, Yingying Mei, Deqing Zhang, Lili Zhu, Canglu Zhu and Yuliang Sheng

School of Computer Engineering, Anhui Sanlian University, Hefei, Anhui, 230601, China

*Corresponding author’s e-mail: jsjgc@slu.edu.cn; yjjyjL@163.com

Abstract. The research is based on the characteristics of instructional software of evaluation and exercise, taking a small examination system for driving license as an example, this study is devoted to exploring a feasible test method for instructional software of evaluation and exercise based on mobile platform. The test method consists of four testing phases of unit and integration testing, functionality testing, comprehensive testing and teaching evaluation which existed research of functionality testing for modern Android mobile Apps is fully used for reference. Furthermore, further work is put forward. Firstly, a special defect management database for bug definition and analysis needs to be established. Secondly, major test points in comprehensive testing phase should be converted to user stories in modern agile testing environment for software exploratory test methods positively.

1. Introduction

Instructional software of evaluation and exercise takes a large number of evaluation exercises as the crucial functionality modules to consolidate the knowledge that is learned by users. It is different from typical instructional software that the key functions of instructional software of evaluation and exercise are self-practice or self-test and feedback to users. It usually exists in the form of teaching aids or plug-ins. By calling the question bank, for the purpose of self-testing or strengthening the training of a certain category of knowledge, but it does not include a course learning system. On one hand, instructional software is rooted in teaching process. But on the other hand, it is inseparable from the supporting of information technology. The development of the instructional software must follow the typical methods of software engineering [1]. The development process on instructional software has come into being the development process model system perfectly, but the testing process on instructional software has not been formed yet [2]. From the perspective of application and functionality of instructional software, Reference [3] proposed that testing of instructional software is more suitable for conventional black box testing method, the testing content mainly includes software navigation testing, interactivity testing, functionality testing, stability testing, installation and uninstallation testing, security testing. Reference [2] proposed a test process model for typical instructional teaching software, which covers software development, testing and evaluation activities. However, from the perspective of software testing, how to implement testing activities effectively and related research work for the "instructional software of evaluation and exercise" in the instructional software category are needs to be further researched [3].

According to the teaching theory and the students' cognitive psychology, different instructional software has different characters and different ways of presentation [4]. Generally, the major
categories of instructional software include demonstration, individual counselling, evaluation and exercise, teaching simulation, thematic learning website, teaching game, network course, educational resource centre, network-teaching platform, teaching network community, MOOC/SPOC platform. Different categories of instructional software have common contents, but also have different characteristics, structures, design concepts and teaching intentions. Instructional software with different architectures provides effective support for the teaching and learning process in different ways and with different advantages [3].

With the continuous development of instructional software, the quality of software product has also come into being. Effective test activities of instructional software will become an indispensable and crucial quality assurance method in the development process. Although various testing methods and their applications have become current research hotspots in the field of software engineering, there are still not many relevant research results on the development of corresponding software testing activities for instructional software of evaluation and exercise. This articledevotes to exploring a feasible test method for instructional software of evaluation and exercise based on mobile platform. The structure of the article is organized as the following: Section 2 describes the major characteristics of the instructional software of evaluation and exercise. Section 3 demonstrates a positive test method. Section 4 gives a specific example for application. Section 5 gives the conclusions and future directions of research.

2. Characteristics of instructional software of evaluation and exercise
The instructional software of evaluation and exercise is composed of a multitude of exercises, and its core function is to conduct learning evaluation and feedback for learners. Generally, the instructional software of evaluation and exercise is in the form of question bank system, such as question bank of computer grade examination. Except for common characteristics of instructional software, there are three characteristics for the instructional software of evaluation and exercise particularly. In the period of mobile application currently, the instructional software of evaluation and exercise which is based on mobile client for learners mostly.

2.1. Exercise selecting algorithm
The strategy of extracting questions in evaluation and exercises is a key factor in evaluating learning effects. The cognitive ability for learners mainly includes random method, adaptive selection method, parameter selecting method, etc.

2.2. Interaction environment
A test environment provided to learners. From the user's point of view, interaction environment is impacted on simulating the real test environment and achieving the role of conducting students to evaluate correctly. Such factors such as test strategy, test time, and answer decisions are included.

2.3. Feedback and evaluation mechanism
The feedback information provided by the software after the learners complete the testing, such as information feedback on rewarding, motivation, penalty, etc. Overall, feedback and evaluation mechanism gives learners the evaluation of ability mastery, which can be combined with learners' cognitive ability.

3. Design of test method for instructional software of evaluation and exercise based on mobile platform
In the period of mobile application, the instructional software of evaluation and exercise is running and applied in the form of mobile APP, that is to say, testing of instructional software of evaluation and exercise based on mobile platform will be complied with the mobile application testing for APPs.

Although a functionality testing method for Android mobile Apps is given in [5]. In this article, a test method for instructional software of evaluation and exercise based on mobile platform is designed.
some of test content for characteristics of instructional software of evaluation and exercise are added and described on the basis of [5].

3.1. Unit and integration testing
The goal of unit testing of instructional software is purely to test whether the code is correct or not in terms of function realization from the perspective of the software's own properties or the instructional software system functionality design, and to ensure the structural safety and reliability of the code, regardless of the educational and teaching factors of the software. It is the same as traditional unit testing. In actual testing process, unit testing for some modules can be delayed appropriately, or the unit testing content as a part of the software subsystem can be executed in integration testing phase of the subsystem, thereby the testing efficiency could be improved effectively. Unit and integration testing for instructional software is also implemented in modern agile testing.

3.2. Functionality testing
In this section, content of functionality testing is fully referenced in [5]. The instructional software of evaluation and exercise based on mobile platform could be considered as a mobile App and Table 1 demonstrates major test content of each fundamental functionality logic verification.

Figure 1 demonstrates a model of test automation pyramid for conducting functionality testing. Unit and integration/component testing for code level can be implemented in lower two layers and various elements of button, menu, dialog box, etc. on UI are identified through testing tools to complete App GUI tests which software exploratory test methods are suggested executing [5]. In the phase of functionality testing for instructional software of evaluation and exercise, existed researches of functionality testing method based on exploratory testing for Android mobile Apps are used in this article.

Table 1. Test content of each fundamental functionality logic verification.

| Fundamental functionality logic verification | Major test content |
|---------------------------------------------|--------------------|
| Installation                                | Whether the App can be installed on the mobile device correctly or not? /Installation path can be customized? /Without the user's permission, the App can be started automatically? /During the software installation process, whether the handling of unexpected situations (crash, restart, power failure) conformance the requirements or not? /…… |
| Permission                                  | Is the App allowed to obtain user data? /If there is risk of privacy disclosure in the App? /User authorization level of the App can be checked? /…… |
| Registration and login                      | Is the App can be login in when the username and password are wrong? / Is there user login cache? / Security of the password is ensured? / User password can be retrieved if it is missed? / Is it correct to login in the App with a disabled account? /…… |
| Uninstallation                              | Whether there is a warning message or not when a user deletes the installation folder to uninstall directly? /How to deal with unexpected situations during app uninstallation? /Does uninstallation support cancel function? /…… |
| Running                                     | Testing of running status after the App is installed. / Whether the switching between pages of the App is smooth, whether the logic is correct, etc. / If an App can be switched between foreground and background correctly? / An App is started after user unlocking the lock screen and test whether it will be crashed? /…… |

Note: Table 1 is referenced in [5]
3.3. Comprehensive testing

The content of the comprehensive testing mainly focuses on the design characteristics of the instructional software of evaluation and exercise to implement corresponding test activities. Table 2 demonstrates major test points and content description, which are conducted for test cases design. Education experts, students, teachers and testers usually complete the evaluation of comprehensive testing together.

Table 2. Major test points and content description of comprehensive testing.

| Comprehensive testing | Major test point            | Test content description                                           |
|-----------------------|-----------------------------|---------------------------------------------------------------------|
| Exercise selecting algorithm | Strategy of automatic test paper generation | Whether a test paper could be generated automatically according to the designing scheme of exercise? |
| Exercise selecting algorithm | Extracting algorithm        | Testing of extracting algorithms, which are designed according to cognitive ability of learners. |
| Exercise selecting algorithm | Exercise management        | Functions of preview, search, edit, print, delete, distribute, etc. of exercise paper are correct? |
| Interaction environment | Human-computer interaction | Students login/quit the system, answer questions, temporarily store answers, papers submit and other tests. |
| Interaction environment | Guidance on exam            | Testing of guidance on exam is correct or not.                      |
| Interaction environment | Exam submit                 | Testing of function of exam submit is correct or not.               |
| Interaction environment | Exam management             | Testing of environment monitoring, logic process of papers reviewing, etc. |
| Interaction environment | Exception handling         | Testing of exception handling of examine, such as system halted.     |
| Feedback and evaluation mechanism | Information feedback        | Testing of information for feedback Whether it helps students answering questions or not. |
| Feedback and evaluation mechanism | Reward and penalty mechanism | Testing of reward and penalty whether it is suitable for learners after they finished the examining. |
### 3.4. Teaching evaluation

Teaching evaluation is an indispensable part of instructional software testing. It aims to evaluate whether the teaching content represented by the instructional software is scientific and whether it achieves the purpose of teaching or learning to promote teaching design. Table 3 demonstrates major content of evaluation from the perspective of teaching effect.

| Teaching effect | Major content of evaluation |
|----------------|----------------------------|
| Students' interest in learning | Whether a students' interest in learning could be improved or not by using the instructional software of evaluation and exercise. |
| Reduce the burden of teachers | Compare with the traditional testing, whether the burden of teachers could be reduced by using the instructional software of evaluation and exercise? |
| Individual learning | Can students implement individual exercises through the instructional software of evaluation and exercise according to their own knowledge? |
| Inquiry exercising | Can students use the instructional software of evaluation and exercise to implementing on inquiry learning and practice activities without ideological burden? |

### 4. Application

As an example, a small examination system for driving license based on Android platform for the first version is the quintessential instructional software of evaluation and exercise. Figure 2 demonstrates the system home interface and the webpage of teacher user login.

![Home interface and the webpage of teacher user login.](image)

Table 4 demonstrates the application of framework of test method for this system. In this framework, Unit and integration testing, functionality testing, comprehensive testing and teaching evaluation are implemented for a process for iteration. Scrum model for agile testing can be applied positively for conducting the test method in this article.

| Unit and integration testing | Functionality testing | Comprehensive testing | Teaching evaluation |
|-----------------------------|-----------------------|-----------------------|---------------------|
| Module 1/Module 2/Module 3/Module 4/…… | Installation/Permission /Registration and login/Uninstallation/ | Exercise selecting algorithm | Students' interest in learning |
Component 1/
Component 2/
Component 3/……

Running/App GUI tests
(software exploratory
test methods are
suggested executing)

Interaction environment

Reduce the burden of

teachers

Feedback and evaluation

mechanism

Individual learning

Inquiry exercising

Note: The four testing phases above form a process for iteration.

5. Conclusions and further work
A test method for instructional software of evaluation and exercise based on mobile platform is
designed for testing of a small examination system for driving license based on Android platform,
through the functionality testing method based on exploratory testing for Android mobile Apps in
existed researches are fully referenced in this test method.

From my own perspective, further work will be done in the future. Firstly, on the basis of bug
definition and analysis, a special defect management database needs to be established in the test
method of this article [6]. Secondly, in comprehensive testing phase, how to convert major test points
to user stories for scrum model in agile testing environment that a multitude of software exploratory
test methods can be used positively.

Acknowledgments
The work was supported by "Project of Natural Science of Anhui Province University" under Grant
No. KJ2020A0809, "Project of Quality Engineering of Anhui Province University" under Grant No.
2019jyxmx0508, "Project of Quality Engineering of Anhui Province University" under Grant No.
2019jxtd122 and "Excellent Young Talent Support Project of Anhui Province University" under Grant
No. gxyq2019138.

References
[1] Yu, J.J. (2018) Research on Exploratory Testing Methods of Special Learning Website. Journal
of Tonghua Normal University, 39: 55-59.
[2] Yu, J.J., Zhang, Y.S. (2014) Research and Application of Testing Process Model for Instructional
Software. Journal of Anqing Teachers College(Natural Science Edition), 20: 125-129.
[3] Yu, S.Q. (2011) The Handbook of Instructional Software Design. Tsinghua University Press,
Beijing.
[4] Yu, J.J. (2017) Discussion on main points on designing of instructional software. MATEC Web
of Conferences., 139: (00009)1-7.
[5] Yu, J.J., Zhang, J.S., Wu, N., etc. (2021) A Functionality Testing Method Based on Exploratory
Testing for Android Mobile Apps. In: International Conference on Computer Network
Security and Software Engineering. Zhuhai. pp. (012031)1-5.
[6] Yu, J.J., Zhu, S.M., Zhang, J.S., etc. (2020) An Agile Testing Framework of Four Quadrants. In:
The International Conference on Communications, Information System and Software
Engineerin. Guangzhou. pp. (012004)1-5.