

Analysis of program comprehension that has effects on the code review achievement

5th COE Postdoctoral and Doctoral Researchers
Technical Presentation

Graduate School of Information Science, Nara
Institute of Science and Technology
D1
Software Engineering Laboratory
Susumu Kuriyama



Software reliability in a ubiquitous environment



- Software reliability is especially important in a ubiquitous environment.
 - Anywhere you go, you will use software.
- To ensure high reliability of software, many technologies and methods have been proposed.
 - Model verification
 - Software testing
 - Review

Analysis of program comprehension that has effects on the code review achievement

COE presentation

2

Review



- Review is an activity in which peers inspect products*, detect bugs, and improve them [1]. (*products: requirement definitions, designs, test items, source codes, etc.)
 - As part of software reliability improvement, many software development fields put review processes into practice.
 - Reviews for source code are called code review.

[1] K.E. Wiegers: "Peer Reviews in Software: A Practical Guide", Addison-Wesley Professional(2001).

Analysis of program comprehension that has effects on the code review achievement

COE presentation

3

Factors that have effects on the quality of code review



- Review method
 - Checklist-based Reading (CBR)
CBR provides an inspector with a checklist, which consists of procedural guidelines and "yes/no" questions.
 - Perspective-based Reading (PBR)
PBR provides an inspector with a scenario that is developed from different perspectives (from users and designer).
- Inspector's understandings on a program
"How do inspectors' understandings on a program have effects on the quality of code review?" is not well examined.

Analysis of program comprehension that has effects on the code review achievement

COE presentation

4

Research objective



- To analyze the relationship between the level of program comprehension and the bug detection rate in a code review process.
 - Inspector's understandings on a program are necessary to detect bugs?
 - If an inspector understands a program well, bugs can be detected?
 - The relationship between the kinds of bugs and easy-to-detect bugs?
 - . . .
 - etc.

Analysis of program comprehension that has effects on the code review achievement

COE presentation

5

Approach



- I classify bugs and examine the relationship between the program comprehension and the code review achievement, according to the classification.
 - Bugs were classified into four kinds.
 - data
 - interface
 - logic
 - specification
- To examine the reviewer's comprehension level of the source code and specification, the examination is given for subjects just after the review.

Analysis of program comprehension that has effects on the code review achievement

COE presentation

6

Classification of bugs



- data
 - bugs derived from operations to global variable, structure, array, heap memory
- interface
 - interface of functions (return value, argument, restriction of call sequence of functions, etc.)
- logic
 - mistake of logic (algorithm, role and condition of flag, loop control.)
- specification
 - lack of function written in specification and function not written in specification.

Analysis of program comprehension that has effects on the code review achievement

COE presentation

7

Experiment overview



- Subjects
 - 11 people
- Experiment procedure
 - 1.Code review
 - Experimenters gave each subject hardcopies of the **source code**, the **specification**, and the **document that is an overview of the program**.
 - The review process was not directed by experimenters but subjects could review the materials freely. However, they could not run the program and use checklists.
 - Review time was not restricted. The review was finished when each subjects thought that all bugs were detected.
 - 2.Program comprehension examination
 - Multiple choice questions.

Analysis of program comprehension that has effects on the code review achievement

COE presentation

8

The program that was reviewed



- A liquor inventory management system
- Written in C programming language, 604 lines of codes
- 29 bugs were included
 - data 7, interface 8, logic 6, specification 8
 - There was no syntax error detected by compiler.

Analysis of program comprehension that has effects on the code review achievement

COE presentation

9

Examples of program comprehension examination.



- Question about classification "data".
 - Are memory blocks of container structure dynamically allocated?

yes / no / I don't know

- Question about classification "interface".
 - Dose function SendLiquor receive carrying date as one of the arguments?

yes / no / I don't know

Analysis of program comprehension that has effects on the code review achievement

COE presentation

10

Program comprehension examination



- Subjects answered the questions without documents (source code, specification, overview document).
 - We assumed "He answered the question correctly. = He well understood the program from the aspect of the question."
 - Although, it is highly possible that results of the examination depends on his memory about the documents.

Analysis of program comprehension that has effects on the code review achievement

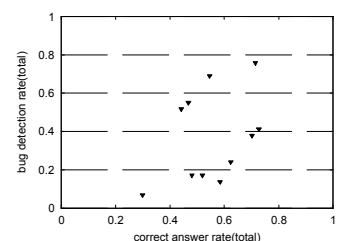
COE presentation

11

Results of the experiment (total)



- No strong correlation was indicated between the bug detection rate and the correct answer rate of the examination.
- Correlation coefficient 0.38



Analysis of program comprehension that has effects on the code review achievement

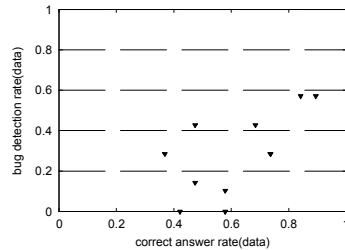
COE presentation

12

Results of the experiment (data)



- The higher the correct answer rate of the examination, the higher the bug detection rate.
- Correlation coefficient 0.63



Analysis of program comprehension that has effects on the code review achievement

COE presentation

13

Discussion (data)



- About the bugs categorized to “data”, higher comprehension level of program lead to more detecting bugs.
 - Correlation coefficient : 0.63
 - When you comprehend, you can find bugs.

Analysis of program comprehension that has effects on the code review achievement

COE presentation

14

Results of the experiment (the others)



- There was no strong correlation between the bug detection rate and the correct answer rate of the examination.
 - There were many bugs that you can easily find with a proper checklist.
 - Example of interface bugs; incorrect actual parameter to function and incorrect handling of return value of function.
 - Whether the subjects confirmed them or not affected the bug detection rate significantly.

Analysis of program comprehension that has effects on the code review achievement

COE presentation

15

Summary



- It is difficult to find the bugs about data structure and data manipulation without understanding the program well.
 - The subjects who had the higher comprehension about data structure and data manipulation showed the higher bug detection rate in the categories.
- Other kinds of bug classifications did not indicate the similar relation.
- Checklists and rule sets would be useful for code review.

Analysis of program comprehension that has effects on the code review achievement

COE presentation

16

Future work



- I should reexamine the relationship between the level of program comprehension and the code review achievement under the use of a checklist or a rule set.
- I have to examine why the subjects who had the higher comprehension about data structure and data manipulation showed the higher bug detection rate in the categories.
 - Need to consider other factors affect review.
 - Would like to build a program comprehension supporting tool about data structure and data manipulation.

Analysis of program comprehension that has effects on the code review achievement

COE presentation

17