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CRITIC-BASED AND COLLABORATIVE APPROACH FOR UML CLASS DIAGRAM

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By

SORAN MAHMOOD ABDULKAREEM

Thesis Submitted to School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Master of Science

November 2015

DEDICATION

To my beloved father and mother

Mahmood Abdulkareem Rahman

Najat Karim Ibrahim

To my dearest wife

Shara Salih Ali

To my siblings and family

Goran M.ABdulkareem

Avan M.Abdulkareem

To my closest friend

Dana Nawzar Ali

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the Degree of Master of Science

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November 2015

Chairman : Norhayati Mohd Ali, PhD
Faculty : Computer Science and Information Technology

Unified Modeling Language (UML) diagrams are used extensively in the academia, especially in the Software Engineering courses at the university level. The UML offers several types of diagrams that can be applied to model the static and dynamic behavior of a software system. One of the most important UML diagrams that are widely used in software engineering courses is UML Class diagrams. Teaching and learning of UML Class diagrams demand a sufficient supervision from the lecturers and also active communication between students and lecturers. Limited time and lack of collaboration in a traditional classroom setting are concerns that constraint the supervision of lecturers in providing feedback to the students about the UML class diagrams. Therefore, a critic-based and collaboration approach is adopted in this research to enhance the feedback process and collaborative learning between students and lecturers in the UML class diagram task. UML class diagram together with critique- based and collaborative approach are the most used tools as a technique in the contemporary research in the field of software engineering. The main aim of this research is to propose a critic-based and collaborative approach for UML class diagrams that can support lecturers and students in the teaching and learning of UML class diagrams. This study also aims to design and develop a UML class diagram critic tool with collaborative features as to improve students' knowledge and collaborative learning in UML class diagrams. Finally, is to perform an end-user evaluation to examine the effectiveness and usability of the UML class diagram critic tool. This research performed several activities to achieve the three objectives stated above. This research was initiated by reviewing the literature on critiquing tools and collaborative approaches. Next, a preliminary survey was conducted with 34 Software Engineering students to obtain their responds on the proposed UML class diagram critic tool and collaboration approach. Key requirements were identified based on the findings from the literature review and preliminary survey which are then used to develop the UML class diagram critic tool. The final stage of this research was the evaluation of the UML Class Diagram Critic tool via an end-user survey, which took into account the usability aspects and the Cognitive Dimensions framework. The results of this research suggest that critic-based and collaboration approach can contributed to the improvement of student's learning and skill in UML class diagram. In addition, the UML Class Diagram Critic tool with collaborative approach would complement the teaching and learning performed in a traditional classroom setting. Thus, collaboration learning between students and lecturer can be enhanced. Through benchmarking, this

research has been compared to the other previous works and it has been explained in detail how this research activates both critic and collaboration which makes the work an addition to the body of knowledge in this field.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

PENDEKATAN BERASASKAN KRITIK DAN KOLABORATIF UNTUK RAJAH KELAS UML

Oleh

SORAN MAHMOOD ABDULKAREEM

November 2015

Pengerusi : Norhayati Mohd Ali, PhD
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Rajah Bahasa Permodelan Bersatu (*Unified Modeling Language (UML)*) digunakan secara meluas dalam bidang akademik, terutamanya dalam kursus Kejuruteraan Perisian di peringkat universiti. Terdapat beberapa jenis gambar rajah UML yang boleh digunakan untuk modelkan tingkah laku statik dan dinamik bagi satu sistem perisian. Salah satu gambar rajah penting UML yang digunakan secara meluas dalam kursus kejuruteraan perisian adalah gambar rajah Kelas UML. Pengajaran dan pembelajaran bagi gambar rajah Kelas UML memerlukan pengawasan yang mencukupi daripada pensyarah dan juga komunikasi aktif antara pelajar dan pensyarah. Masa yang terhad dan kurangnya kerjasama dalam persekitaran bilik kuliah tradisional merupakan factor yang mengekang penyeliaan pensyarah dalam memberi maklum balas kepada pelajar tentang gambar rajah kelas UML. Oleh itu, satu pendekatan berasaskan kritik dan kolaboratif telah digunakan dalam penyelidikan untuk untuk meningkatkan proses maklum balas dan pembelajaran kolaboratif antara pelajar dan pensyarah bagi tugas gambar rajah kelas UML. Tujuan utama penyelidikan ini adalah untuk mencadangkan pendekatan berasaskan kritik dan kolaboratif untuk gambar rajah kelas UML yang boleh membantu pensyarah dan pelajar dalam pengajaran dan pembelajaran gambar rajah kelas UML. Kajian ini juga bertujuan untuk merekabentuk dan membina alat kritik gambar rajah kelas UML dengan ciri-ciri kolaboratif untuk meningkatkan pengetahuan pelajar dan pembelajaran kolaboratif dalam gambar rajah kelas UML. Akhir sekali, adalah untuk melaksanakan penilaian pengguna akhir untuk menilai keberkesanan dan kebolehgunaan alat kritik gambar rajah kelas UML. Penyelidikan ini melibatkan beberapa aktiviti untuk mencapai tiga objektif yang dinyatakan di atas. . Penyelidikan ini telah dimulakan dengan mengkaji literatur tentang alat kritikdan pendekatan kolaboratif. Seterusnya, kajian awal telah dijalankan dengan 34 pelajar Kejuruteraan Perisian untuk memperolehi respon mereka tentang alat kritik gambar rajah kelas UML dan dan pendekatan kolaboratif yang dicadangkan. Keperluan utama telah dikenal pasti berdasarkan hasil dari kajian literatur dan kajian awal yang kemudiannya digunakan untuk membangunkan alat kritik gambra rajah kelas UML. Peringkat akhir penyelidikan ini adalah penilaian terhadap alat kritik gambar rajah kelas UML melalui kaji selidik pengguna akhir, yang mengambil kira aspek kebolehgunaan dan rangka kerja Kognitif Dimensi. Hasil kajian ini menunjukkan bahawa pendekatan berasaskan kritik dan kolaboratif boleh menyumbang kepada peningkatan pembelajaran pelajar dan kemahiran dalam gambar rajah kelas UML. Di samping itu, alat kritik gambar rajah kelas UML dengan

pendekatan kolaboratif akan melengkapkan pengajaran dan pembelajaran yang dijalankan dalam persekitaram bilik kuliah tradisional. Dengan ini, pembelajaran kolaboratif antara pelajar dan pensyarah boleh dipertingkatkan

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
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LIST OF ABBREVIATIONS

UML	Unified Modeling Language.
CDs	Cognitive Dimension of framework.
CDC	Class Diagram Critic.
SE	Software Engineering.
CW	Cognitive Walkthrough.
TA	Think Aloud.
HE	Heuristic Evaluation.
EPC	Event Driven Process Chain.
HeRA	Heuristic Requirements Assistant.
EMF	Eclipse Modeling Framework
JDT	Java Development Tools
JFT	Java Server Tools

CHAPTER 1

INTRODUCTION

This chapter presents an overview of the research in Unified Modeling Language (UML) class diagram, critiquing systems/tools and collaborative approaches. It describes the background of the research area and introduces the motivation. This chapter also explains the problem statement, research objectives and research methodology and research contributions. Finally, the chapter concludes with the thesis organization.

1.1 Research Background and Motivation

There is a vast consensus on the need of modeling languages in software engineering activities. One of these modeling languages is Unified Modeling Language (UML) which is a widely used modeling language in software engineering (SE), mainly for object-oriented software development. This object-oriented system of notation has evolved from the work of (Bellin et al., 2000;and; Booch, et al., 1998). UML is a general-purpose visual modeling language that is used to specify, visualize, construct, and document the artifacts of a software system(Clavel, Manuel, 2006). There are several types of UML diagrams for modeling system from different perspectives. One of the most important diagrams of UML is Class Diagram which is the backbone of almost every object oriented method, including UML and it is used to represent the static view of a system. According to Maraee & Balaban (2014) class diagrams are the most essential and best understood model among all UML models and its language allows complex constraints on its components.

The UML is not only used by the software engineering practitioners but is typically adopted in various Computer Science courses such as software engineering, object-oriented analysis and design, object-oriented programming, and object-oriented software development. Most universities teach the UML to ensure that students will acquire the design and modeling skills which are considered important for software development profession (Akayama et al., 2013). In addition, previous survey done by Erickson & Siau (2007) reported that UML class diagram is needed in object-oriented software development. Akayama et al. (2013) also claim that object-oriented design and modeling area is a key interface between research and teaching. Much research has been devoted to UML supporting tools. For instance, SketchUML (Lin Qiu, 2007), StudentUML (Ramollari & Dranidis, 2007), and UMLGrader (Hasker, 2011) are some of the UML supporting tools which focus on assisting students with class diagram modeling.

1.2 Problem Statement

In designing UML class diagrams, students are highly dependent on a number of supporting tools that provide UML modeling features. However, as reported by Ramallori & Dranidis (2007), most available UML-based tools are designed for professional use making it difficult for students to use them. Software designs problems are complicated and require a lot of time and energy (Hammond & Davis, 2006). In addition, most students require sufficient guidance from their lecturers for understanding and solving UML class diagrams assignments/exercises. But, the traditional classroom setting constrains the ability of a lecturer in providing feedback to students on UML class diagrams assignments/exercises due to the limited time (Baghaei & Mitrovic, 2006). A critic-based and collaborative learning approach to support students with their designs in UML class diagrams is required. An educational class diagram critic tool with a collaborative approach to facilitate and achieve the process of effective feedback between students themselves and with their lecturer is proposed. According to this UML Class Diagram-based tool problems stated will reach a solution. This tool helps lecturers as well as students and complements what they do in the class (Coccol et al.,2011).The tool can be used by professionals as well as beginners addressing a problem existing in previous critiquing tools. The tool also saves time for students and lecturers alike through enhancing collaboration among students themselves and with their lecturers.

1.3 Research Objectives

The main aim of this research is to provide critiquing support and collaboration learning capabilities in a Class Diagram tool that can assist the software engineering (SE) students in learning the design of UML class diagrams in a simple way. In particular this research has three objectives:

1. To propose a critic-based and collaborative approach to support the SE students in UML class diagram tasks. This is to improve student knowledge and modeling skill in UML class diagram.

2. To design and develop a simple critic-based and collaborative approach that is embedded in a UML Class Diagram tool

3. To evaluate the effectiveness of critic-based and collaborative of the UML Class Diagram tool in an end user evaluation survey.

1.4 Research Questions

The main research questions in this research in relation to the problem statement and research objectives are as follows:

1. How can a critic-based and collaborative approach be integrated with existing UML Class Diagram model? This question is addressed in Chapter Four (A Critic-Based and Collaborative Approach for UML Class Diagram).

2. How can such an integrated approach be evaluated? This question is addressed in Chapter Five (Results and Discussion).

1.5 Research Contributions

This research contributes to the domain of software design specifically to UML class diagram critiquing tools and collaboration approach. It has three main contributions to this field:

1. This research designs and develops a UML class diagram critiquing tool. It is easy-to-understand and easy-to-use tool, which fits the students of software engineering in the best way. It is not directed to high-skilled software engineering experts but students who could be in the beginning stages of their education in the area.

2. This research provides architecture of a new UML class diagram and collaboration approach to know the activity of the user and each steps of using the new critic tool.

3. Through proposing a critic-based and collaborative approach, this tool provides information related to the critiquing tools and collaboration approach. One can find knowledge on the existing tools in this study. These critiquing tools are not only limited to UML class diagrams but also scattered throughout different areas of software engineering. Thus, the thesis provides information to those who want to get introduced to critiquing tools in class diagram area.

4. This research illustrates the collaboration and the tool's enhancing collaboration among students themselves and with their lecturers combined with its automatic critiquing features has made the critic tool an ideal tool to be used in educational institutions. End-user evaluation of the tools shows that this critic tool may have big effect if used as a helpful and complimentary to the traditional classroom.

5. Critic-based and collaboration approach used in this research help students get improved feedback on UML Class diagrams. Thus, the research brings all these elements together to provide a better tool answering to the needs of software design students with high dependence on UML Class Diagrams.

1.6 Scope of the Research

This research is conducted in the area of software engineering, more specifically, software design. Moreover, UML Class Diagram has been chosen as it is the most widely used diagram in software design (Erickson and Siau, 2007). UML Class Diagram served the objectives of this research the best as it is a research in higher education area with a focus on students and lecturers. Among its different usages, this research is focused on UML Class Diagram's usage in critiquing, both automatic and manual, and its role in enhancing collaboration.

1.7 Thesis Organization

This thesis is organized in accordance with the standard structure of thesis consists of six chapters. It begins with an introductory chapter ending with a concluding chapter.

Chapter 2, an extensive review of literature is made. The literature review covers two main areas of literature related to the topic: critic tools and collaboration approach. Most of the known tools that have been previously introduced are examined. Consequently, the gaps in the existing tools are identified which was the lack of a comprehensive solution for student's problems in critiquing and collaboration approaches.

Chapter 3, the methodology of conducting the study is explained in detail. Also necessary explanation on the different steps of conducting the research is given by starting from the preliminary survey to the final survey and evaluation of the results. In addition the data collection and data analysis methods are carried out.

Chapter 4, the design and the implementation of the class diagram critiquing tool are explained. Firstly, a general description of how the idea of the implementation of the tool is described and the architecture of the diagram-critiquing tool is discussed.

Chapter 5 consisted of the evaluation of the class diagram critic tool and based on the results of the end-user evaluation survey. The concept of evaluation is explained and followed by specifying the different criteria for determining the usability of the critic tool. The final chapter, Chapter 6, discusses the limitation of this research in detail. It also speaks about possible future work that will add to the existing scholarship.

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APPENDICES

Appendix (A): Tools and collaboration approach in software design.

Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
Survey Title: Tools and collaboration approach in software design

My name is Soran Mahmood and I am a Master student at the Faculty of Computer Science and Information Technology, UPM. I am conducting a research on software design critiquing tools with collaboration approach. This research is under the supervision of Dr. Norhayati Mohd Ali and Dr. Novia Indreaty Admodisastro. Our research investigates the use of the automatic and manual critiquing tools while conducting software design tasks. Part of our research involves an evaluation of the student knowledge of software design tools and collaborative learning in software design.

You are invited to participate in this survey as you are 2nd year software engineering student who enrolled (SIM3304) software design . Participation in this survey is on a voluntary basis and is performed in an anonymous way. No personal information will be collected during the survey. Your comments and assistance would be greatly appreciated.

Aim of the survey:

• To collect data from software engineering students in order to evaluate software engineering students' level of knowledge and background in software design.

• To find out the level of dependency of software engineering students on supporting tools to assist them in software design tasks.

• To evaluate the students' view about collaborative learning tools during in supporting their software design tasks.

Description of collaboration learning and critiquing tool:

- Collaborative learning: Is an educational approach to teaching and learning that involves groups of students and teachers working together to solve a problem, complete a task, or create a product.
- Software design critiquing tool: Software design critiquing tools are intended to provide guidance to perform the software design task more effectively.

Kindly mark the appropriate box next to your choice with (✔)

Section I: Respondent background and knowledge in software design task.

1.1-How do you rate yourself in the knowledge and background in software design?

☐ Poor

☐ Average

☐ Very good

1.2 – How do you model your software design?

- ☐ Sketch on paper
- ☐ Drawing tools (such as Microsoft Visio, Microsoft word, …..)
- ☐ Modeling tools; which of the following modeling tool(s) do you use?
    - ☐ ArgoUML
    - ☐ UMLStar
    - ☐ UML2
    - ☐ Green UML
    - ☐ Rational Software Architect (RSA)
    - ☐ Others, please specify ( )

1.3- How long have you been using software design tool(s)?

- ☐ 0 to 6 month(s)
- ☐ 6 to 12 months
- ☐ 12 to 24 months
- ☐ More than 2 years

1.4 – How do you rate yourself in using the software design tool(s) to support your software design task?

- ☐ Easy
- ☐ Average
- ☐ Difficult

Section II: Student view regarding supporting tool for software design task.

2.1 – Would you like to have a supporting tool such as software design critiquing tool (e.g., ArgoUML) to support your software design tasks?

☐ Yes

☐ No

2.2 - Using software design critiquing tools makes the software design task faster and more effective.

☐ Strongly agree

☐ Agree

☐ Average

☐ Disagree

☐ Strongly disagree

2.3. The student gets support feedback/suggestions from the supporting tool before sending their software design task assignments to the lecturers.

☐ Strongly agree

☐ Agree

☐ Average

☐ Disagree

☐ Strongly disagree.

2.4 Student can improve their skills and knowledge of software design tasks based on the advice/critics provided by the supporting tool.

☐ Strongly agree

☐ Agree

☐ Average

☐ Disagree

☐ Strongly disagree.

Section III: Collaborative learning among software engineering students.

3.1- Do you prefer to work in groups (e.g. with classmates) to solve the software design task?

☐ Yes

☐ No

3.2 –When and where do you prefer to work with your classmates to perform the software design task?

☐ Outside class hours

☐ During class hours (in class or in the lab)

3.3- Which level of software design task that requires your lecturers' assistance?

☐ Beginning of the exercise

☐ Throughout the exercise

☐ Before submit the exercise

3.4- Collaborative learning between student- lecturers, student-student is an effective way of improving the learning of software design.

☐ Strongly agree

☐ Agree

☐ Average

☐ Disagree

☐ Strongly disagree

Thank you for taking your time to complete and submit this survey. Your response is highly appreciated.

Should you have any queries or concern regarding this survey or its questions, please do not hesitate to contact me. You can email me at: soransorany@gmail.com ,you may also contact my supervisor, Dr. Norhayati Mohd Ali at hayati@fsktm.upm.edu.my or 03-89471764.

Appendix (B): Survey tittle: Evaluation of a Class Diagram Critic Tool with a Collaborative approach.

Faculty of Computer Science and Information Technology
Universiti Putra Malaysia

Survey: Evaluation of a Class Diagram Critic Tool with a Collaborative Approach

My name is Soran Mahmood and I am a second year master student at University Putra Malaysia, faculty of Computer Science and Information Technology. This research is under the supervision of Dr. Norhayati Mohd Ali and Dr.Novia Indriaty Admodisastro. The objectives of this survey are 1) To determine the impacts of Class diagram critic tool on the student's design; 2) To illustrate whether the critiquing tool has a positive influence on the students skill or not; 3) To evaluate collaboration elements in this critiquing tool. You will be asked questions on your experience using the different features of the critiquing tool while working on your design tasks.

You are invited to participate in this survey as you are software engineering student who have enrolled in (SIM3304) software design course. Participation in this survey is on a voluntary basis and is performed in an anonymous way. No personal information will be collected during the survey. The survey may take up to 50 minutes of your precious time. Your comments and assistance would be greatly appreciated.

Should you have any queries or concerns regarding this questionnaire or its questions, please do not hesitate to contact me. You can email me at: soransorany@gmail.com. You may also contact my supervisor, Dr. Norhayati Mohd Ali at hayati@upm.edu.my or 03-89471764.

Thank you,

Kind regards,

Student Name: Soran Mahmood

Matric number: GS34977

Survey: Evaluation of a Class Diagram Critic Tool with a Collaborative Approach

This survey is structured into TWO sections. Section one, provides the task list that need to be performed by the participants. Section Two, provides a questionnaire that should be answered by the participants once they have completed the tasks.

SECTION ONE: TASK LIST ON USING THE CLASS DIAGRAM CRITIC TOOL

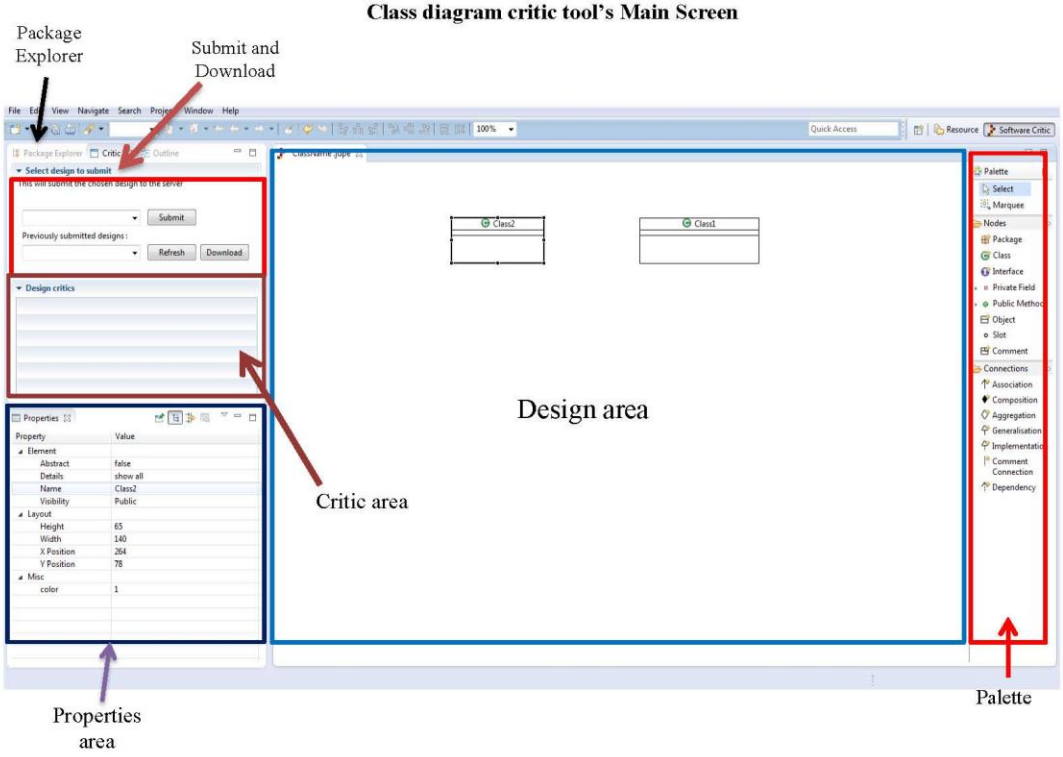
Purpose: To allow the participant to explore and use the Class Diagram Critic Tool. Next, the participants are required to design/draw a class diagram model using the Class Diagram Critic Tool based on a given problem. Participant can ask question while doing the task.

Instruction: Please read and perform the following task steps.

TASK 1. Explore and Use the Class diagram critic tool.

Class diagram critic is a critic tool for modeling UML class diagrams, which help students to fix their designs through manual and automatic critiquing. Class diagram critic allows students and their lecturers to collaborate whenever they work on the design tasks.

Class diagram critic tool's Main Screen

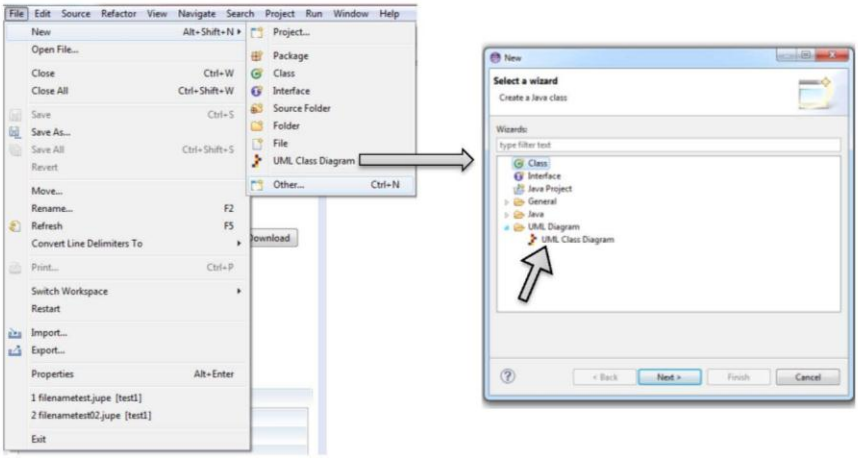


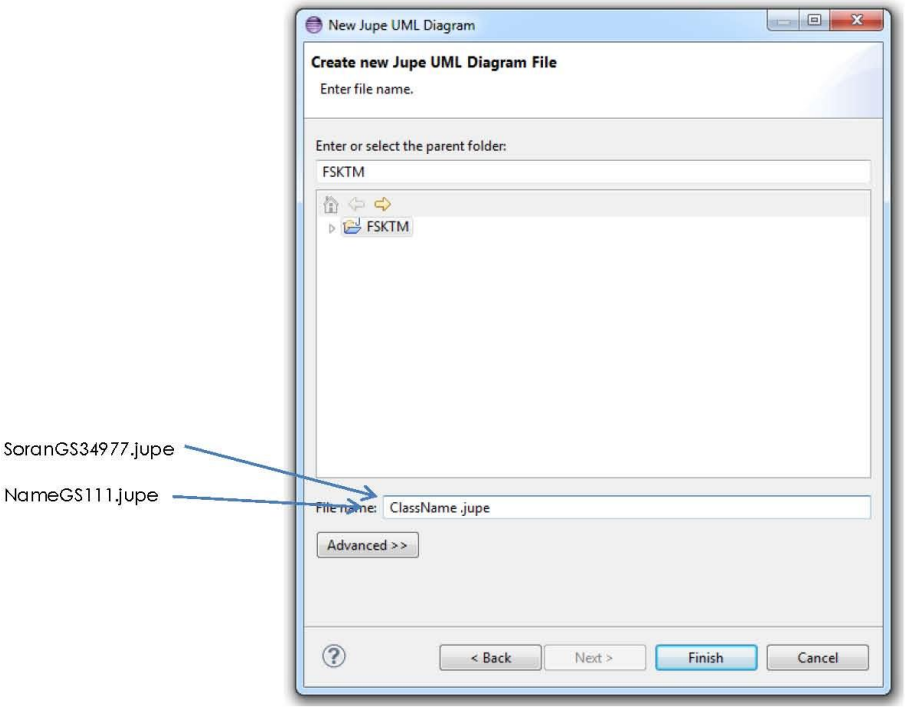
TASK 2. Design/Draw Class Diagram

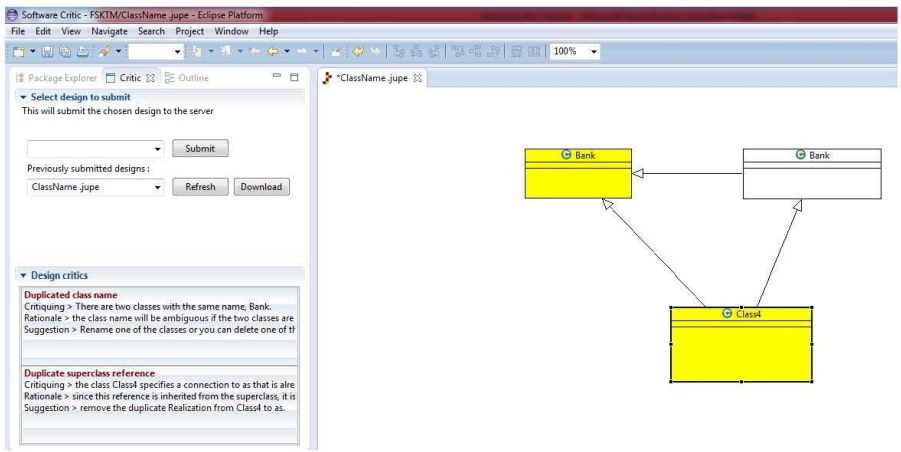
- Right Click of the area (Package Explorer) New > Project > Java Project > Next > Name.
- Select (project name, for example : FSKTM) File menu> New > Other > UML diagram > UML class diagram

- Naming class diagram, example (SoranGS1111.**jupe**, HeshamGSN3259.**jupe**) > Finish.

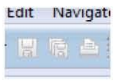
Note.
Create a UML class diagram by using the palette an automated critiquing is executed while designing the model/diagram. Warnings in a form of text and color will be displayed if there are any potential mistakes in the design.





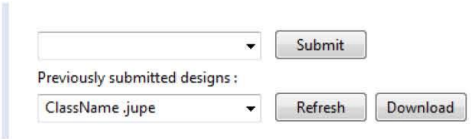


- Save the diagram

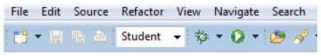


- Submit the diagram

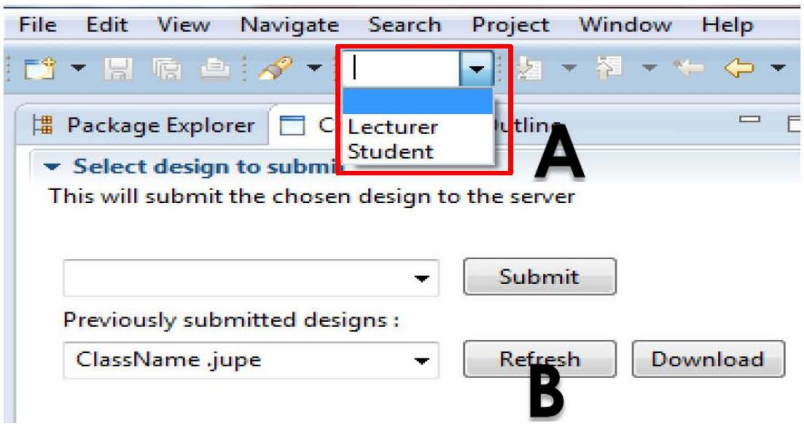
Click combo box > choose design > Submit

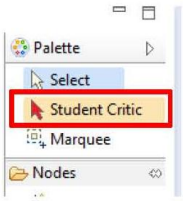


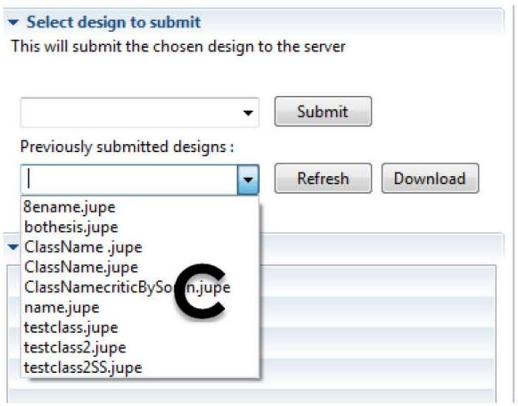
TASK 3. Perform Student Critic

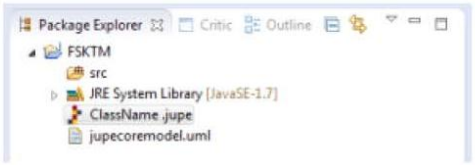


- Choose **Student Critique** to start manual critiquing (A)
- Click **Refresh** button (B), to refresh all the designs in server.
- There are lists of files names in the combo box(C).
- Choose any file of the design from the list > **Download**









- Double click the class name at the **Package** area.
- Add critic to the diagram by using the palette.
  - Critic example: In one class the Attributes name must not be repeated.

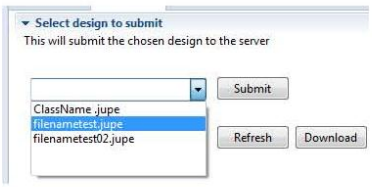
- **Save** 

- **Rename File.jupe**
  Package Explorer > select the design > File menu > Rename (File.jupe)

Note. Naming the UML Class diagram file, naming class diagram according to first name of the class and you can add (EditByName) for example (NameGS1111**EditeByName**.jupe).

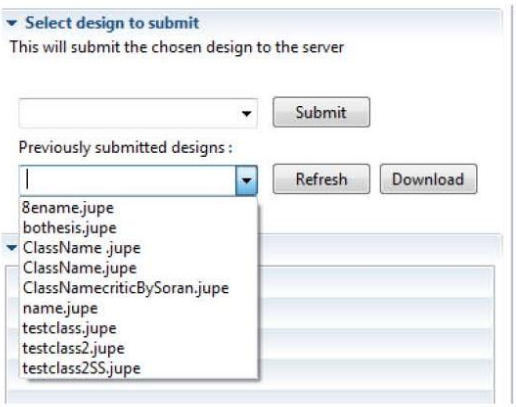
- **Submit the diagram**

  Click combo box > choose design > Submit



TASK 4. View comment from other users

- There are lists of file names in the combo box. Choose any of the design from the list > **Download**



- Double click the class name at the **Package** area.

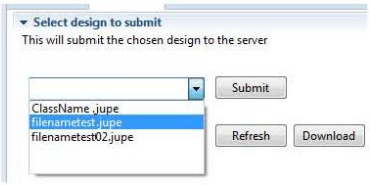
Note. Download your design with a new name that made by other participants, you can edit or submit without changing any part of the design

TASK 5. Final Submission of Assignment

- **Rename File.jupe**
  Package Explorer > select the design > File menu > Rename (File.jupe).

- **Submit the diagram**

  Click combo box > choose design > Submit



END OF TASK.

After you complete the above task, please answer the questionnaires in SECTION TWO.

SECTION TWO: QUESTIONNAIRE

Instruction: Please answer the following questions.

Note.
Please provide your response by circling the numbers.

Part I- Usability of the Critiquing Tool.

5 = Very easy	5 = Strongly agree
4 = Easy	4 = Agree
3 = Moderately	3 = Neither Agree or disagree
2 = Slightly easy	2 = Disagree
1= Not at all easy	1 = strongly Disagree

1.1 **Learnability**

A. I can get to the information quickly.

Strongly Disagree 1 2 3 4 5 Strongly agree

B. It is easy to learn how to use it.

Not at all easy 1 2 3 4 5 Very easy

C. Information is easy to read.

Not at all easy 1 2 3 4 5 Very easy

D. My mistakes were easy to be corrected.

Not at all easy 1 2 3 4 5 Very easy

1.2 **Error and Satisfaction**

A. It is fun to explore the critic tool.

Strongly Disagree 1 2 3 4 5 Strongly agree

B. I would recommend this critic tool to a friend.

Strongly Disagree 1 2 3 4 5 Strongly agree

C. I am satisfied with this critic tool.

Strongly Disagree 1 2 3 4 5 Strongly agree

1.3 **Memorability**

A. It is easy to remember where to find things.

Not at all easy 1 2 3 4 5 Very easy

B. I always felt I knew what was possible to do next.

Strongly Disagree 1 2 3 4 5 Strongly agree

C. Information is written in a style that suits me.

Strongly Disagree 1 2 3 4 5 Strongly agree

Part II - Cognitive Dimension of Class Diagram Critic Tool

2.1 It is easy to navigate different menus and options embedded in the tool.

Not at all easy 1 2 3 4 5 Very easy

2.2 The uploading and downloading of the diagrams from the tool is convenient.

Strongly Disagree 1 2 3 4 5 Strongly agree

2.3 The palette presented in the tool facilitates to create and edit the diagrams easily.

Strongly Disagree 1 2 3 4 5 Strongly Agree

2.4 When I need to make changes to previous works, it is easy to make the change.

Not at all easy 1 2 3 4 5 Very easy

2.5 There are particular changes that are more difficult or especially difficult to make.

□ Yes

□ NO

If, Yes, please explain----------.

2.6 It is easy to check in the middle of creating class diagrams.

Not at all easy 1 2 3 4 5 Very easy

2.7 There were steps seemed complex or difficult to work out in my head (e.g. download design or submitting a design).

□ Yes

□ NO

If, Yes, please explain----------.

Part III- Assessment of Collaboration Elements in the Tool.

3.1 Collaboration at the same time and in the same place enhances design task.

Strongly Disagree 1 2 3 4 5 Strongly agree

3.2 Communication with lecturer and other students with critic tool enhance my class diagram design.

Strongly Disagree 1 2 3 4 5 Strongly agree

3.3 Collaboration (such as exchange ideas via manual critiquing and submit assignment via online) are an important element to support the collaborative learning.

Strongly Disagree 1 2 3 4 5 Strongly agree

Part IV- Student's Suggestions

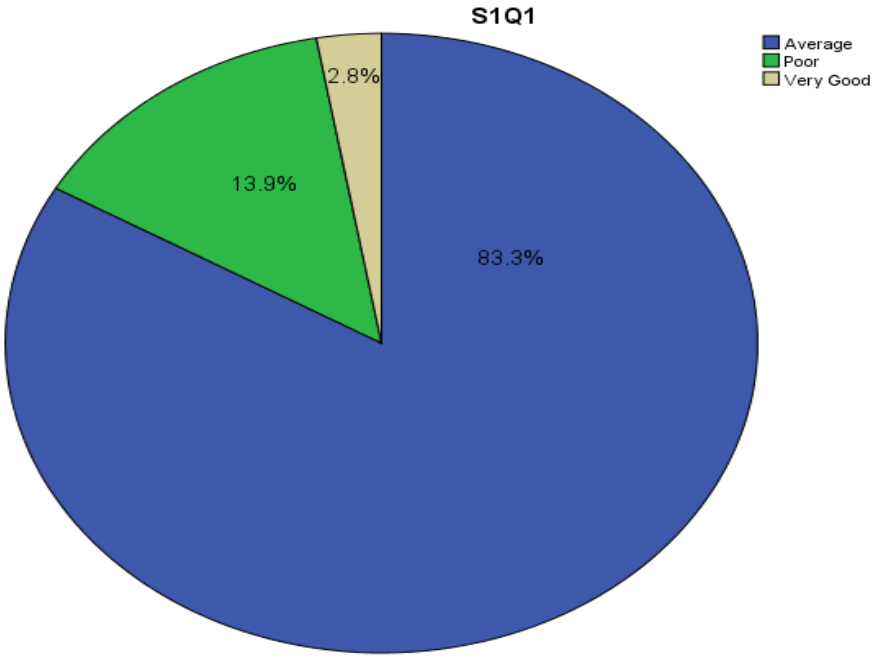
After completing this questionnaire, can you think of ways that the critic tool could be improved? What are they?

Thank you for taking your time to complete and submit this questionnaire. Your response is highly appreciated.

Appendix (C): Results of the preliminary survey conducted are as follows.

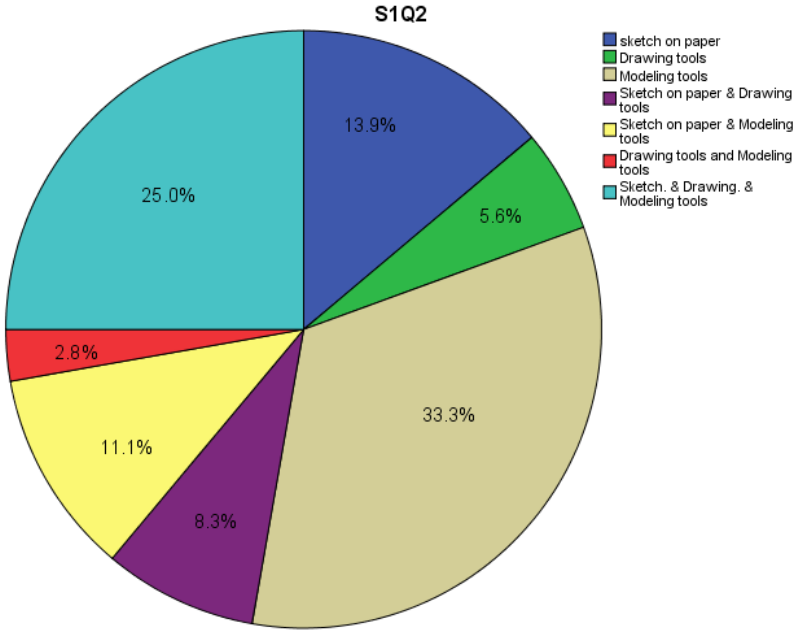
Section I: Respondent background and knowledge in software design task.

1.1-How do you rate yourself in the knowledge and background in software design?

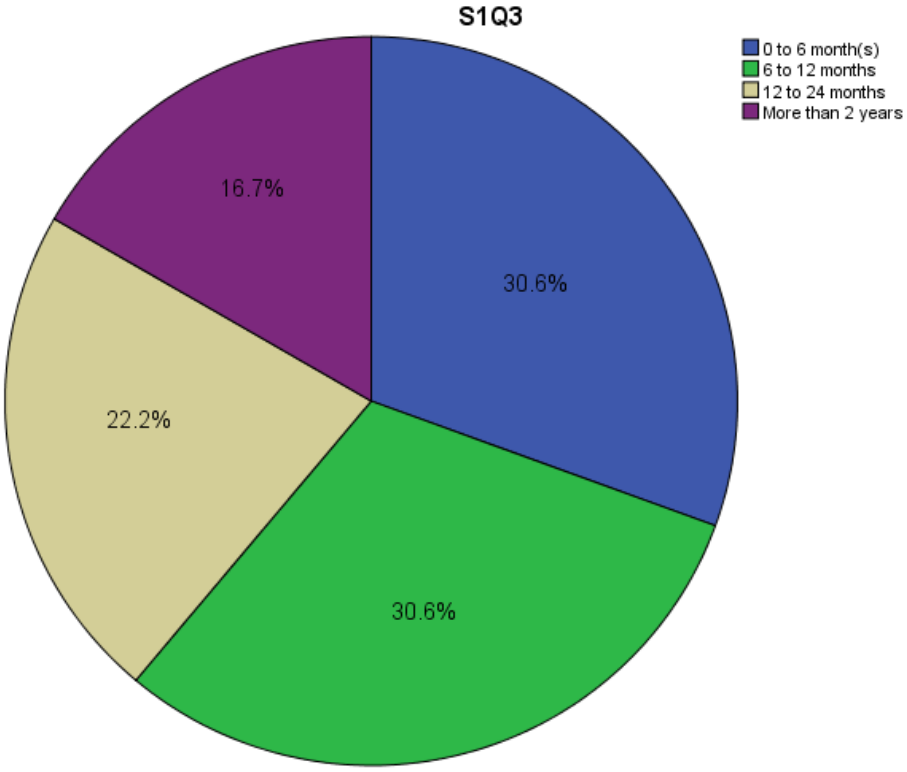


Knowledge and background in software design.

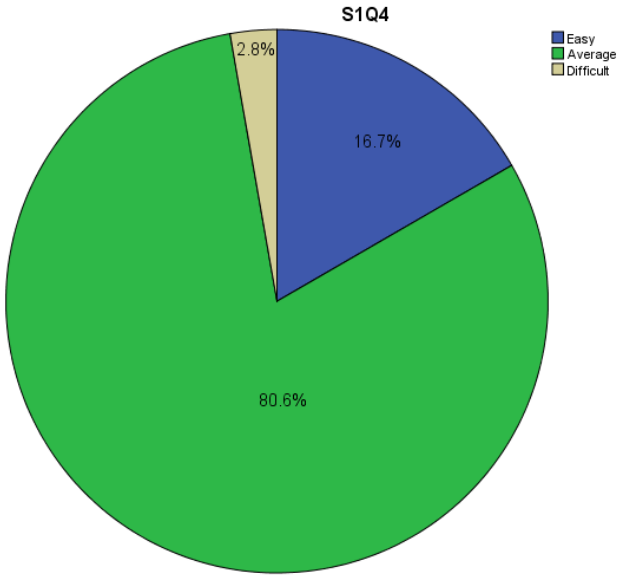
1.2 – How do you model your software design?



1.3- how long have you been using software design tool(s)? (Software design tool(s))

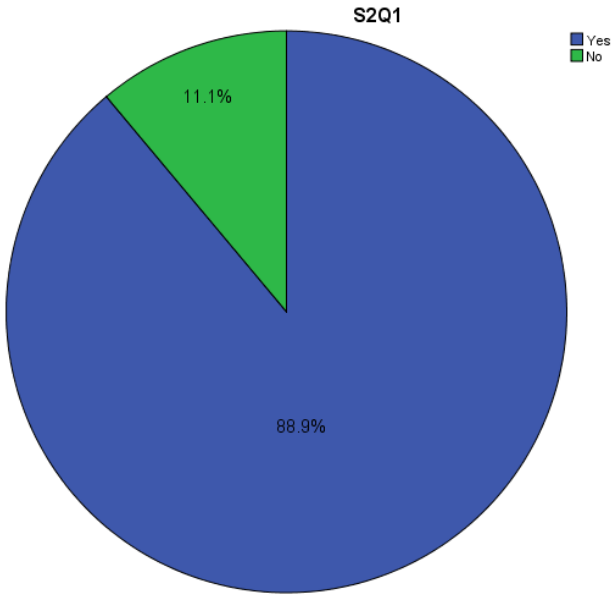


1.4 – How do you rate yourself in using the software design tool(s) to support your software design task?

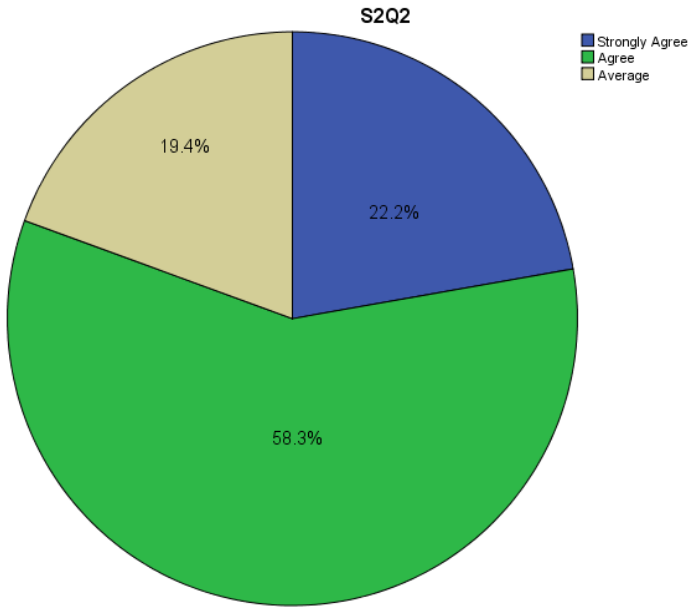


Section II: Student view regarding supporting tool for software design task.

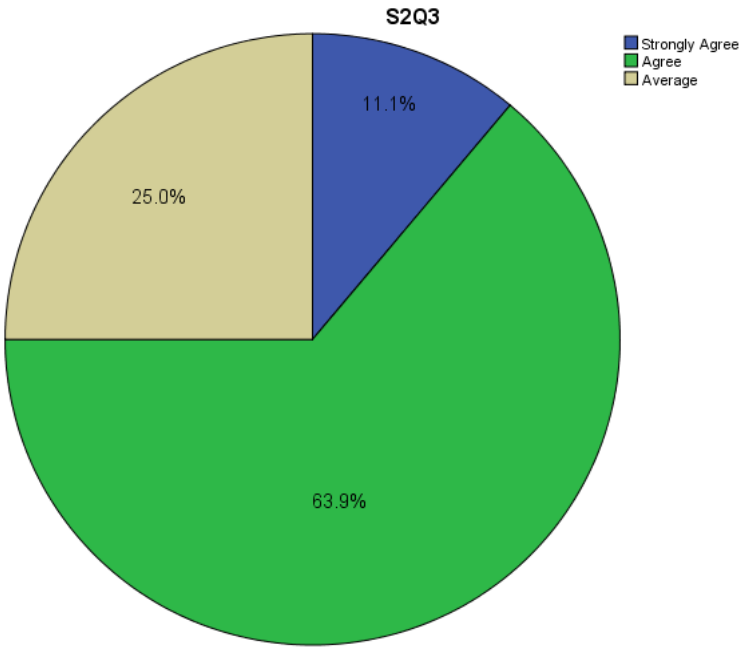
2.1– Would you like to have a supporting tool such as software design critiquing tool (e.g., ArgoUML) to support your software design tasks?



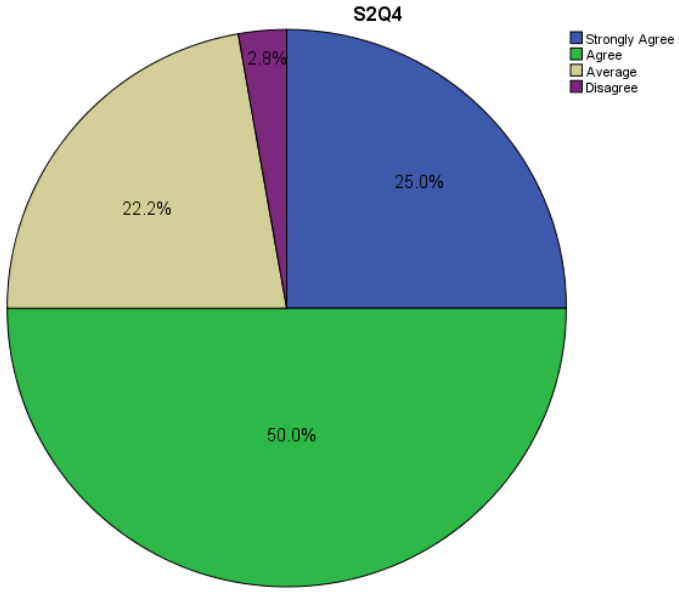
2.2- Using software design critiquing tools makes the software design task faster and more effective.



2.3- The student gets support feedback/suggestions from the supporting tool before sending their software design task assignments to the lecturers.

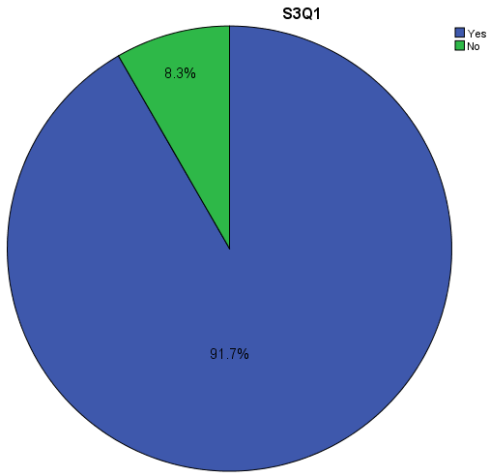


2.4- Student can improve their skills and knowledge of software design tasks based on the advice/ critics provided by the supporting tool.

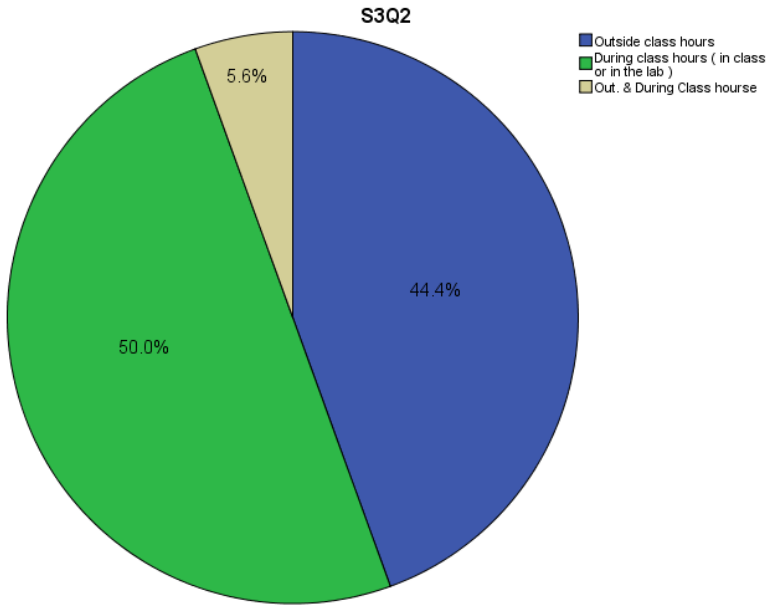


Section III: Collaborative learning among software engineering students.

3.1- Do you prefer to work in groups (e.g. with classmates) to solve the software design task?



3.2 –When and where do you prefer to work with your classmates to perform the software design task?



Appendix (D): The interview form.

Introduction of interviewer

Hello, my name is Soran Mahmood and I am a second year master student at University Putra Malaysia, Faculty of Computer Science and Information Technology. This research is under the supervision of Dr. Norhayati Mohd Ali and Dr.Novia Indriaty Admodisastro, and I am thankful to you for giving your precious time for the interview. Please be assured and comfortable that your feedback will be kept confidential and will be used only for the declared purpose.

During the interview, I would like to discuss regarding different aspects of the Critic tool and collaboration approach to improve class diagram, I would like to ask you the following questions. I may start with your permission. Thank you for granting the permission.

Main questions	Additional questions	Clarifying questions
What do you think about CDC tool? Or What is your opinion about CDC tool?	• It is easy to learn. • Can you get to the information quickly? • It is easy to learn how to use it.	• Can you expand a little on this? • Can you tell me anything else? • Can you give me some examples?

What do you think about the satisfaction of CDC Or What is your view about the satisfaction of the critic tool?	• It is fun to explore the critic tool. • I would recommend this critic tool to a lecturer. • I am satisfied with this critic tool.	• Can you expand a little on this? • Can you tell me anything else? • Can you give me some examples?
What is your opinion about the Memorability?	• It is easy to remember where to find things. • I always felt I knew what was possible to do next. • Information is written in a style that suits me.	• Can you expand a little on this? • Can you tell me anything else? • Can you give me some examples?
What is your opinion about editing, coloring, comments in CDC? And What is your opinion about the	• It is easy to navigate different menus and options embedded in the tool. • The uploading and downloading of the diagrams from the tool is convenient. • The palette presented in the tool facilitates to create and edit the diagrams easily. • When I need to make changes to previous	• Can you expand a little on this? • Can you tell me anything else? • Can you give me some examples?

server connection?	works, it is easy to make the change. • There are particular changes that are more difficult or especially difficult to make. • It is easy to check in the middle of creating class diagrams. • There were steps seemed complex or difficult to work out in my head (e.g. download design or submitting a design).	
What is your opinion about the collaboration learning? Especially between students and lecturers?	• Collaboration at the same time and in the same place enhances design task. • It is easy to collaborate with students and give them the comments, editing the diagrams, coloring diagrams. • Communication with student with critic tool enhances class diagram design. • Collaboration (such as exchange ideas via manual critiquing and submit assignment	• Can you expand a little on this? • Can you tell me anything else? • Can you give me some examples?

	via online) is an important element to support the collaborative learning. • One of the most important aspects in this critic tool is user name and password, for lecturer critic part?	
Can you think of ways that the critic tool could be improved? What are they?	• What is your idea to improve critic tool?	• Can you expand a little on this?

BIODATA OF STUDENT

Soran was born in July 1st, 1984 in Sulemanyah, Kurdistan region, North of Iraq. He is the youngest son of Mahmood and Najat. He received his primary education in Amanj primary school in Sulemanyah. In 2005 he managed further his study in Bachelor of statistics and computer for 4 years in university of Sulemanyah, Sulemanyah, Kurdistan. He started his master degree at the Faculty of computer science and information technology, UPM with the specialization of software engineering.

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