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Dissecting <u>Design Effort</u> and <u>Drawing Effort</u> in UML Modeling

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INTRODUCTION

- One argument in the discussion about the adoption of *modeling* in industry is the supposedly large effort it takes to do modeling.
- We want to find out how much of the modeling effort is spent on the *design* of the solution, and how much effort is spent on *drawing* the solution.





Design Effort vs. Drawing Effort

- **Design Effort**: is the effort devoted to thinking about the design, i.e. pondering and making the design decisions.
- Drawing Effort: is the effort devoted to creating, deleting and organizing the graphical representation of the design.



- Design
- - Layout

RESEARCH QUESTIONS

- **RQ1** How much of the modeling effort is design, DEP?
- RQ2 How much of the modeling effort is notation expression, NEEP?
- **RQ3** How much of the modeling effort is layout, LEP?
- RQ4 Does the *size* of the modeling scenario affect DEP, NEEP and LEP?
- RQ5 Does the *topic* of the modeling scenario affect DEP, NEEP and LEP?

- We conduced 2 *two-phase* experiments:
 - Phase 1 **Modeling**: Create a UML class model.
 - Phase 2 **Copying**: Re-draw the same modeling solution. •
- We estimate **DE**, **NEE** and **LE** by assessing the time difference between the two phases.

APPROACH

- Our approach considers that the effort of software modeling encompasses three parts:
 - Design Effort (**DE**),
 - Notation Expression Effort (NEE), and
 - Layout Effort (LE)



Design vs. Drawing

- Are we capable of thinking while drawing and viceversa? Yes!
- Our calculations indeed estimates the *minimum* Design Effort.





Modeling Tool



RESULTS of EXP1

RQ1,2,3: How much is the DEP, NEEP and LEP?



RESULTS of EXP2

RQ1,2,3: How much is the DEP, NEEP and LEP?



Comparing the efforts spent on Scenario2 in EXP1 and EXP2

- There are two factors that could affect the DEP, NEEP and LEP:
 - A. the modeling tool and,
 - B. number of involved subjects per modeling task

(MANN-WHITNEY TSET)

Data	Mann-Whitney U	sig. 2-tailed
DEP	52.000	0.001
NEEP	42.000	0.000
LEP	125.000	0.249

Post-Experiment Questionnaire

Feedback	Results				
	Experiment	Med.	Q1	Q3	I-Q. R.
	EXP1	2	1	3	2
Expertise in software modeling	EXP2	3	2	3	1
	EXP1	2	1	2	1
Experience in using UML	EXP2	2	2	3	1
	EXP1	4	4	4	0
Clarity of the scenarios	EXP2	4	3	4	1
	EXP1	4	3	4	1
Usability of the modeling tool	EXP2	3	2	3	1

Legend:

Med: Median Score Q1: First Quartile Q3: Third Quartile I-Q.R.: Inter-Quartile Range

RESULTS (RQ4)

RQ4: Does the size of the modeling scenario affect DEP, NEEP and LEP?

NUMBER OF CLASSES AND ASSOCIATIONS IN THE SOLUTIONS	OF :	EACH
MODELING SCENARIO		

Scenario	N of classes			N of associations				
	Med.	Q1	Q3	I-Q. R.	Med.	Q1	Q3	I-Q. R.
1	8.00	7.00	8.00	1.00	7.00	6.00	7.00	1.00
2	6.00	4.00	9.00	5.00	5.00	3.00	8.00	5.00
3	6.50	6.00	7.75	1.75	5.50	5.00	6.75	1.75

IMPACT OF THE SIZE OF MODELS (KURSKAL-WALLIS TEST)

Data	Chi-square	df	p-value
N of Classes	4.151	2	0.126
N of Associations	4.151	2	0.126

RESULTS (RQ5)

RQ4: Does the topic of the modeling scenario affect DEP, NEEP and LEP?

IMPACT OF THE TOPIC OF THE SCENARIO ON DEP, NEEP AND LEP (KRUSKAL-WALLIS TEST)

Data	Chi-square	df	p-value
DEP	1.040	2	0.595
NEEP	1.630	2	0.443
LEP	4.325	2	0.115

IMPACT OF TOPIC BETWEEN EVERY PAIR OF SCENARIOS (MANN-WHITNEY TEST)

	DEP (sig. 2-tailed)	NEEP (sig. 2-tailed)	LEP (sig. 2-tailed)
S1 - S2	0.408	0.316	0.168
S1 - S3	0.343	0.244	0.046
S2 - S3	0.949	0.733	0.394

SUMMARY



- Design
- Drawing:
 - Notation Expression
 - Layout



- Two-Phase Experiments
 - 1. Modeling
 - 2. Copying
- Assess the time difference between the two phases

CONCLUSION

The design effort (thinking about the design) takes <u>at least</u>:

- 56% of the total task effort in EXP1
- 74% of the total task effort in EXP2

TAKEAWAY

- The Stanford marshmallow experiment
 - Delayed gratification.
- UML Modeling would reward 3 Marshmallows!
 isignificant thinking about the design, and
 enhance productivity and quality*

* D. Budgen et al. "Empirical evidence about the UML: a systematic literature review", 2011

* B. Anda et al. "Experiences from introducing UML-based development in a large safety-critical project", 2006

TAKEAWAY

- UML Modeling would reward 3 Marshmallows!
 - significant thinking about the design, and
 - enhance productivity and quality.

THANK YOU!

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