Experiment to Evaluate SPMDL and SMML

1. INTRODUCTION

To validate the proposed approach, we conducted an experiment with 8 software engineering students taking the software metrics course. We report our experiment following the guidelines proposed by Jedlitschka et al. to report experiments in software engineering [1]. In this validation, we compare the development of metrics using SPMDL versus SMML [2]. The reason for selecting SMML for comparison is that both SPMDL and SMML were built as research projects with the same objectives and both provide tool support. The objective of the experiment is to evaluate if metrics are easier to define and understand in SPMDL as compared to SMML. We defined the following research question: "Is defining and understanding metrics in SPMDL easier than in SMML?" Therefore, the goal of the experiment is to analyze metric definitions represented with SPMDL and with SMML with the purpose of comparing them, with regard to the ease of definition and ease of readability, from the point of view of software engineering experts.

1.1 Experiment Subjects

The subjects are 13 (8 graduate and undergraduate students of software metrics course in addition to 5 software engineering experts). All of the subjects are not familiar with SPMDL or SMML. The independent variables are SPMDL and SMML, while the dependent variable is language usability and definition readability.

1.2 Experiment Material

Before the subjects started the experiment, we provided them with two sets of materials:

a. Languages documentation: the documentation for both SPMDL and SMML to make them familiar with specifying metrics using these two languages.
b. Survey: to evaluate language usability and definition readability of the two languages.

1.3 Experiment Variables and Hypotheses

To measure usability, we asked the following questions for both languages:

a. How easy is it to learn to define new metrics?
b. How confident are you in defining different metrics?

To measure readability, we asked the following question for both languages:

c. How easy is it to read the generated description?

In addition, the survey contained a free text question that asked the subject to: Comments about their experience with SPMDL as compared to SMML.

To investigate the research question, we set the following two hypotheses:

Hypothesis 1: Null hypothesis: Defining metrics using SPMDL is not easier than defining metrics in SMML.
Alternative hypothesis: Defining metrics using SPMDL is easier than defining metrics in SMML.

Hypothesis 2: Null hypothesis: reading metric definitions written using SPMDL is not easier than reading metric definitions written using SMML.
Alternative hypothesis: reading metric definitions written using SPMDL is easier than reading metric definitions written using SMML.

1.4 Comments Reported by Experiment Subjects

Experiment subjects reported a few comments; the most relevant comments are summarized below:

- “SPMDL is easier to read since it is XML-like format, SPMDL hides the XML complexity.
- The icons (elements) used in SMML are not self-explanatory; thus, the user has to memorize the relationships between icons. While for SPMDL, the XML tags (elements) are self-explanatory due to the hierarchical relationships between XML tags.
- For a software engineer, writing pseudo code to calculate metrics and then convert it to XML tags is easier as compared to converting it to the graphical diagram of SMML.
- Since SPMDL is based on XML, parsing the generated code using XML parser is easier as compared to the graphical notation of SMML.
- SPMDL tool supports usability as the number of clicks to define, compute and represent the metrics are less than the overall process of SMML.
- Due to the simplicity and the attractive setting of SPMDL editor, the editor motivates users to use its functionalities in computing and representing the defined metrics.
- In SPMDL, button names have almost one meaning. However, SMML has different types of icons/symbols which may provide more than one interpretation; this might confuse the user, if he/she did not have enough training.

1.5 Experiment Execution

The subjects were not given a specific exercise to use for metric definitions; instead, they were asked to select any exercise of their choice and to fill the evaluation based on the relative comparison between the two languages. The survey also included a free text question to allow subjects to write their comments about their experience with SPMDL as compared to SMML. The subjects were given a short tutorial on the objectives of SPMDL and SMML as a startup.

15 surveys were distributed; one survey was not returned and one was incomplete. Accordingly, we had 13 complete surveys, which we used to perform the analysis. The descriptive analysis of the results obtained from the survey is shown in **Error! Reference source not found.**1.

Table 1. Experiment Descriptive Statistics

	SPMDL		SMML		p-value
	Median	Std Dev	Median	Std Dev	
Language Learnability					
How easy is it to learn to define new metrics?	4	0.52	3	0.87	<0.05
How confident are you in defining different metrics?	4	0.58	3	1.13	<0.05
Language Learnability Median	**4**	**0.59**	**3**	**0.99**	<0.05
Readability					
How easy is it to read the generated description?	5	0.66	3	1.17	<0.05

To formally assess which mean differences are statistically significant we used a paired t-test (significance level a = 0.05). Based on the results obtained from the survey, we can observe that the average ease of learning SPMDL scored higher (4) than learning SMML (3). Therefore, for hypothesis 1, we reject the null hypothesis and we accept the alternative hypothesis; i.e. defining metrics using SPMDL is easier than defining metrics using SMML.

The ability to read metric definitions presented in SPMDL scored higher (5) than in SMML (3). Therefore, for hypothesis 2, we reject the null hypothesis and we accept the alternative hypothesis; i.e. reading metric definitions written using SPMDL is easier than reading metric definitions written using SMML.

References

[1] A. Jedlitschka, M. Ciolkowski, and D. Pfahl, "Reporting Experiments in Software Engineering," in *Guide to Advanced Empirical Software Engineering*, F. Shull, J. Singer, and D. I. K. Sjøberg, Eds. London: Springer London, 2008, pp. 201-228.

[2] B. Mora, F. García, F. Ruiz, and M. Piattini, "SMML: Software Measurement Modeling Language " in *In The 8th OOPSLA Workshop on Domain-Specific Modeling*, Nashville, USA, 2008.