Paper: Reverse Engineering and Software Products Reuse to Teach Collaborative Web Portals: A Case Study with Final-Year Computer Science Students

Authors: Fuensanta Medina-Dominguez, Maribel Sanchez-Segura, Arturo Mora-Soto and Antonio Amescua

FEEDBACK OBTAINED AFTER APPLYING THE TEACHING STRATEGY PROPOSED

In order to validate the teaching strategy described, the following parameters were analyzed: a) Changeability (time taken to make a change), b) Time for project development, c) Correlations between the above parameters, d) Functionalities that are not working properly, e) Students' grades.

In this section, sample 1 (29 groups of three students each) represents the students who used the MOSS manuals. Sample 2 (22 groups of three students each) represents the students who used the new strategy described in this paper.

A) Changeability. The maintainability of the projects developed was selected as a parameter to be measured because it is widely recognized that maintainability is a very important problem in software development, ranging from between 60 and 90 percent of life cycle costs [30], [31]. Consequently, it is considered a very important quality characteristic in this work. Maintainability can be evaluated through several quality sub-characteristics [32] such as analyzability, changeability, testability, stability and maintainability compliance. In this validation the sub-characteristic – Changeability has been analyzed.

   The changeability (time taken to develop a change) of the web portals developed in 2008-2009, using the new strategy, is lower than that of those in 2007-2008.

   In order to confirm this, a change was required after developing each project. The time taken to make the change was stored and the analysis of the data obtained is summarized in Table VI and Fig. 5. A T-test and the representation of the Interval-plot were used.

H0: the changeability of both samples is the same.

Table VI Statistics Summary

	Var 1	Var 2
Count	29	22
Average	5.5	4
Mode	7	4
Variance	1.01	0.42
Std Deviation	1.008	0.64
Minimum	8.0	2.0
Maximum	11.0	4.0
Range	3.0	2.0
Stnd. skewness	-0.294341	-0.
Stnd. kurtosis	-1.24671	-0.929
T student	27.51 DF:49	
P - Value	0.000	

Var 1: time (in hours) to perform a change in a project where the MOSS manual was used (sample 1).

Var 2: time (in hours) to perform a change in a project where new reuse and reengineering were used (sample 2).

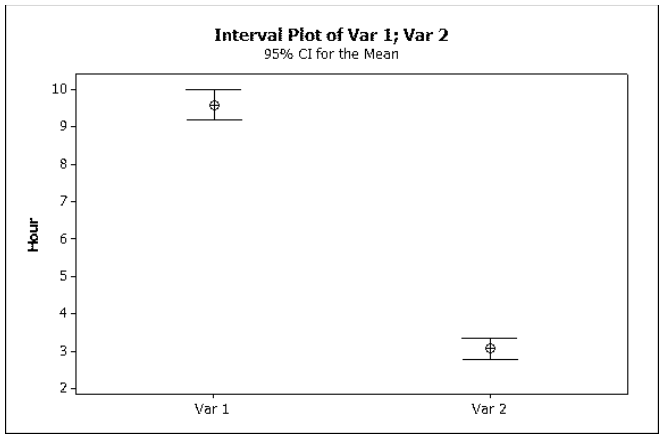

Fig. 5. Interval Plot – Time to make a change

With a p-value of 0.000, lower than 0.05, H0 can be rejected. So the changeability of both samples is different. And, as Fig. 5 shows, with the new strategy, the time taken to make a change on projects was reduced.

On average the time required to make a change on a web portal after step four of the strategy, where functional mistakes were detected, is four hours for the groups that used the proposed strategy and 5.5 hours for the groups from the previous year. Well-documented portals improve their maintainability.

B) Time for Project Development. The time the students spent developing their projects was compared. The phases, which were analyzed individually, were: analysis, design and documentation software engineering techniques used, development and test.

1) Phase I: Analysis, design and documentation (ADD) of software engineering techniques used.

The time taken to develop the ADD phase was stored, and the analysis of the data obtained is summarized in Table VII and Fig. 6. A T-test and the representation of the Interval-plot were used.

H0: the time spent in the ADD phase of both samples is the same.

Var 1: time (in hours) taken to perform the ADD phase in a project where the MOSS manual was used (sample 1).

Var 2: time (in hours) taken to perform the ADD phase in a project where new reuse and reengineering were used (sample 2).

Table VII Phase I Statistics Summary

	Var 1	Var 2
Count	29	22
Average	7.03448	14.8864

Mode	7.5	18
Variance	2.08805	6.95076
Std Deviation	1.44501	2.63643
Minimum	4.5	10.0
Maximum	9.5	19.0
Range	5.0	9.0
Stnd. skewness	0.131385	-0.276856
Stnd. kurtosis	-1.30535	-1.04135
T student	-13.11 DF:49	
P - Value	0.000	

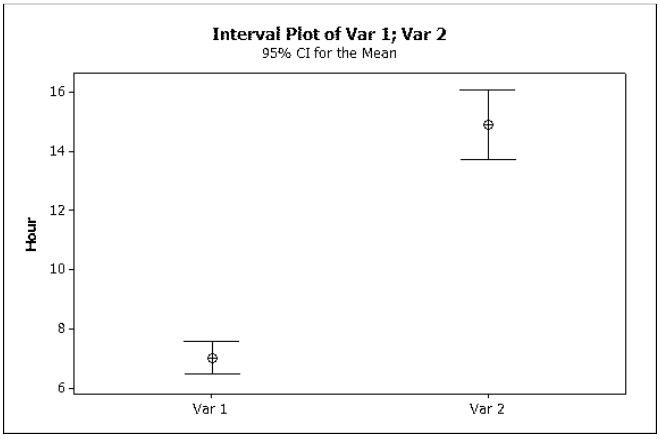

Fig 6. Interval Plot – ADD Phase development

With a p-value of 0.000, lower than 0.05 H0 can be rejected. So, the ADD development time of both samples is different. And, as Fig. 6 shows, the time dedicated to the ADD phase increased in projects where the new strategy was applied, due to the use of software engineering techniques. However, as will be seen later in the correlation analysis, the test phase time was reduced.

2) Phase II: Development phase

The time taken to implement the development phase was stored and the analysis of the data obtained is summarized in Table VIII and Fig. 7. A T-test and the representation of the Interval-

plot were used.

H0: the time spent in the development phase of both samples is the same.

Var 1: time (in hours) taken to perform the development phase in a project where the MOSS manual was used (sample 1).

Var 2: time (in hours) taken to perform the development phase in a project where new reuse and reengineering were used (sample 2).

Table VIII Phase II Statistics Summary

	Var 1	Var 2
Count	29	22
Average	29.97	29.86
Mode	29	33
Variance	12.62	6.98
Std Deviation	3.55	2.64
Minimum	23.5	25
Maximum	37	34
Range	13.5	9.0
Stnd. skewness	0.68	-0.47
Stnd. kurtosis	-0.53	-0.87
T student	0.07 DF:49	
P – Value	0.948	

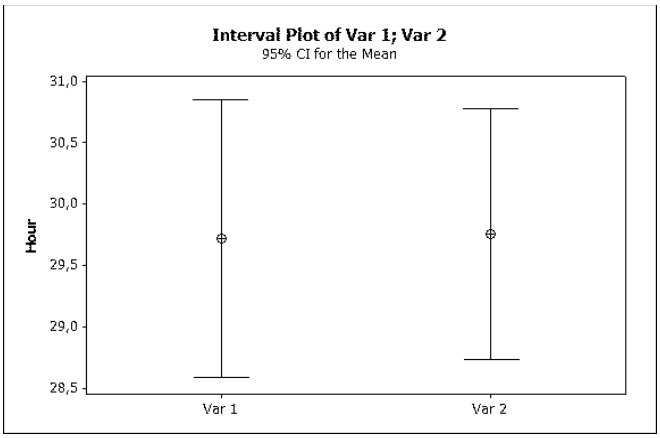

Fig. 7. Interval Plot – Development Phase implementation

With a p-value of 0.945, greater than 0.05 H0 cannot be rejected. So there is no difference between the development time of both samples.

3) Phase III: Test phase

The time taken to develop the test phase was stored; the analysis of the data obtained is summarized in Table IX and Fig. 8. A T-test and the representation of the Interval-plot were used.

H0: the time spent in the test phase of both samples is the same.

Var 1: time (in hours) taken to perform test phase in a project where the MOSS was used (sample 1).

Var 2: time (in hours) taken to perform the test phase in a project where new reuse and reengineering were used (sample 2).

Table IX Phase III Statistics Summary

	Var 1	Var 2
Count	29	22
Average	22.91	15.06
Mode	29	33
Variance	11.34	7.27
Std Deviation	3.37	2.7
Minimum	15	11
Maximum	29	19
Range	14	8
Stnd. skewness	-1.46	0.10
Stnd. kurtosis	-0.053	-1.298
T student	9.24 DF:49	
P - Value	0.000	

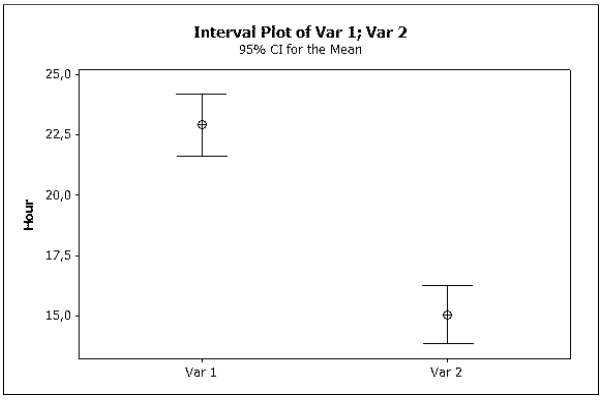

Fig. 8 Interval Plot – Test Phase development

With a p-value of 0.000, lower than 0.05 H0 can be rejected, so the test time of both samples is different. And as can be seen in Fig. 8, the time dedicated to the test phase decreased in projects where the new strategy was applied. This was due to the use of software engineering techniques in the analysis phase, as will be shown below in Subsection IV.C.

The time taken to develop the web portals was very similar in both academic years. But it can be observed in Fig. 9 that, on average, the time distribution during the development of the project is different.

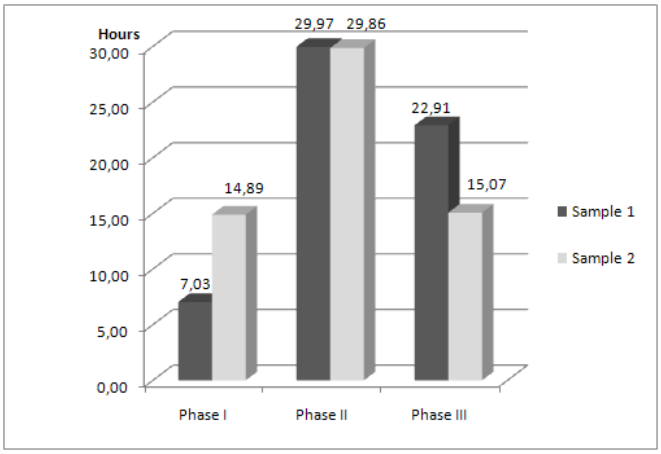

Fig 9. Time dedicated to each phase: data comparison