SESeLE and ITS EFFECTIVENESS: AN EMPIRICAL STUDY

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Abstract - In this research paper, the author have evaluated the SESeLE (Software Engineering Simulation Based e-Learning Environment) on the basis of subjective data gained from a controlled experiment that evaluated the effectiveness of SESeLE with the help of a standard software project model. This was done by providing a scenario-driven interactive single-learner environment that can be accessed through the internet by using a standard web-browser through the SESeLE tool. The training module used in the study is composed of course material on project planning and control. The core element of the training module is a set of inter related project management (i.e. planning) models, represented by a simulation model that was created by using the System Dynamics (SD) simulation modeling method.

Keyword - Simulation, pre-test, post-test, Behaviour, empirical patterns,project management issues, "simple" project dynamics, "complex" project dynamics, experimental group, control group.

INTRODUCTION

SESeLE (Software Engineering Simulation Based e-Learning Environment) was developed to overcome the limitations of e-learning and support the traditional learning environment. In order to make the learners aware of the activities of e-learning platform in SESeLE, a group of learners as subjects was identified. For this purpose, we approached Panjab University and its affiliated colleges, where we earmarked some learners from Computers Science related courses such as Bachelor of Computer Application i.e. B.C.A. and Master of Science in Information Technology i.e. M. Sc. (I.T.) and some from the non Computers Science courses such as Bachelor of Arts i.e. B.A., Bachelor of Science in Information Technology i.e. B. Sc. (I.T.), Bachelor of Commerce i.e. B. Com. etc who had studied computers or I.T. as secondary courses earlier. In this research we have done the factor analysis based on Computer Science Students.

Based on the simulations, it is possible to demonstrate that catering to the software requirements volatility is an extremely effort consuming for the software development organizations and that investments in systems engineering, in order to stabilize requirements definition, will well pay off. For the model users, the results of the simulation experiments provide a twofold advantage. Firstly, a deeper understanding of the procedures for capturing and changing requirements grew up in the assessment team while discussing about real life and its representation through the model. Secondly, the quantitative evaluation of the present situation and of the effect of possible changes is convincing for the organization. The model results help a lot to broaden the view of the requirements process within software development and to start an improvement programme across all the roles and organizations participating in this process. Note, that all results produced by the simulation models are based on qualitatively formulated assumptions underlying the model structure. Without thorough review of the model structure by experts and without a calibration of the model parameters and model functions to empirical data, the model cannot be used for precise point estimates in the sense of a predictive model. However, for the model users, having such a simulation model at hand makes it quite easy to visualize the critical project behaviour and to discuss the assumptions about the cause-effect relationships that are supposed to be responsible for the generated behaviour.

In order to examine the effectiveness of computer-based training in the field of software project management using an SD simulation model implemented through the SESeLE tool, a controlled experiment applying a 'pre-training test post-training test' control group design was conducted. The learners who participated in the experiment were made to appear in two tests, one before the training session (pre-training test) on SESeLE and one after the training session (post-training test) on SESeLE. The effectiveness of the training was then evaluated by comparing scores from post-training test to pre-training test scores, and by comparing the scores between two categories of learners: (a) the learners in the experimental group, i.e. those who used the SDM, and (b) the learners in the control group, i.e. those who used a conventional project planning model instead of the SDM. The following dimensions were used to characterize "effectiveness" of the training session:

1. Interest in software project management issues.
2. Knowledge about typical behaviour patterns of software development projects.
3. Understanding of "simple" project dynamics.
4. Understanding of "complex" project dynamics.

In the study, these dimensions were represented by dependent variables (DV1 to DV4).

BENEFITS OF SIMULATIONS FOR EXPERIENTIAL LEARNING

5. There is abundance of literature on the experiential learning approach, incorporating scenario-based learning, case studies and role-play, all of which are commonly used in simulations [1][2][3][4][5]. This approach consists of a four-stage cycle: concrete experience, observation and reflection, abstract conceptualisation and active experimentation. Kolb et al. in [3] regard experience as the source of learning and emphasise the importance of assimilation of concrete experiences followed by observation and reflection on them in order to develop abstract concepts. In [6], he emphasizes on a student-centered approach to learning and also suggests that the

experience of teaching is a dynamic process of renewal.

6. The experiential learning is often associated with the notion that learners should educate themselves rather than be educated conventionally and it is often a feature of learning through simulation [7]. The concept also draws on work relating to the ecology of human development which enables analysis of the social system factors influencing learner's experience of their own learning spaces and on situated learning theory proposed [8]. This theory considers learning as a transaction between the person and the social environment. It may not necessarily refer to the physical spaces, but constructs the person's experience in the social environment.
7. Reeves et al. in [9] show that scenario-based e-learning is akin to experiential learning: both are carried out in real contexts. In scenario-based learning, they suggest that the learning is a natural by-product of authentic activities commonly used in the community of practice in which the learner is involved. The experience involves following success and failure paths through a realistic situation, something which is usually built into simulations.
8. As far as the assessment of the effectiveness of experiential learning is concerned, common conceptual concerns do not exist within the groups of researchers whose scholarly focus is experiential learning, and at times the validity of simulation are questionable. Cherryholmes in [10] has identified the following four ways of addressing the shortcomings in the field of using simulations in e-learning:
9. Attend to research design by incorporating pre-tests and post-tests, treatment and control groups, and random assignment to groups.
10. Define outcome variables and ensure that they are objective, and appropriate for the experience being assessed.
11. Tie learning measures to explicit learning goals.
12. Ensure that measures are valid.
13. Although use of simulations is broad, attempts to evaluate their effectiveness have been narrow. It appears that over a period of time, the extent of usage of simulations exceeded the level of research focusing on it.

HYPOTHESES

Two null hypotheses together with their associated alternative hypotheses have been stated. The first Null Hypothesis is stated as:

Null Hypothesis H0,4.1: There is no difference between scores before (pre-training test) and after (post-training test) the training session.

The second Null Hypothesis is stated as:

Null Hypothesis H0,4.2: There is no difference in effectiveness of the experimental group (using the SDM) and the control group.

The alternative hypotheses, i.e., what was expected to occur, have been stated as:

1. H1 (relates to H0,4.1) – "post-training test versus pre-training test scores": The average performance of all learners (experimental group and control group) during the post-training test is better than that during the pre-training test.
2. H2 (relates to H0,4.2) – "Performance improvement": The average performance improvement of the experimental group is better than the average performance improvement of the control group.
3. H3 (relates to H0,4.2) – "Post-training test performance": The average post-training test scores of the experimental group are better than the average post-training test scores of the control group.

H1, H2 and H3 apply to all dependent variables (DV 1 to DV4). Note that it is not expected that both alternative hypotheses of H0,4.2 will occur simultaneously. This reflects on the fact that occurrence of alternative H2 is less likely when pre-training test scores of the experimental group are significantly higher than those of the control group. Similarly, alternative hypothesis H3 is less likely to occur when pre-training test scores of the control group are significantly higher than those of the experimental group. Standard significance testing was used to analyze the effectiveness of the training session.

LEARNERS

The participants of the study were computer science learners at the Panjab University who were enrolled in the advanced software engineering class lasting one semester. While the course was running, learners were asked if they would be interested in participating in an experiment related to software project management issues that would involve a simulation model. The learners knew that they would have to participate in a self learning training session, that they would have to pass a test, and that the test scores would be analyzed to evaluate the training session.

As the learners to take different classes at different times during their studies, information on their personal background with regard to experience in software development and software project management was captured before passing the pre-training test.

BEHAVIOURS

The training sessions of both groups, experimental and control, was structured by training scenarios, consisting of a sequence of scenario blocks. The generic scenario structure is composed of the following four scenario blocks (please see Table 4.1).

S. No.	Scenarios	Description
1	Block 1	Interest in software project management issues
2	Block 2	Knowledge about empirical patterns
3	Block 3	Understanding of simple project dynamics
4.	Block 4	Understanding of Complex project dynamics

TABLE 4.1: THE GENERIC SCENARIO STRUCTURE

BEHAVIOUR OF THE EXPERIMENTAL GROUP

The experimental group is made to go through all the blocks. They were asked to answer all the questions corresponding to each scenario in each block.

BEHAVIOUR OF THE CONTROL GROUP

The control group is made to go through only scenario blocks 1, 3, and 4. This group answered questions corresponding to only scenario (block) number 1, 3 and 4.

EXPERIMENTAL SETUP

For evaluating the effectiveness of a training session using SDM simulation, a pre-training test post-training test control group design was applied. This design involves random assignment of learners to an experimental group and a control group. Both groups have to go through a pre-training test and a post-training test. The pre-training test measured the performance of the two groups before the 'behaviour', and the post-training test measures the performance of the two groups after the 'behaviour'. By studying the differences between the post-training test and pre-training test scores of the experimental group and the control group, conclusions have been drawn with respect to the effect of the 'behaviour' (i.e. the independent variable of the experiment) on the dependent variable(s) under study.

EXPERIMENTAL VARIABLES

During the experiment, data for three types of variables are collected. In this section, we list all the experimental variables, including one independent variable, four dependent variables, and three variables that represent potentially disturbing factors.

INDEPENDENT VARIABLES

The independent variable (i.e. 'BEHAVIOUR') can have two values, either TA, which is applied to the experimental group, or TB, which is applied to the control group. The difference between TA and TB is basically determined by two factors (please see table 4.2). The first factor is the training scenario according to which the course material is presented. The second factor is the planning model that is used to support software project management decision making.

In this section, we briefly summaries the difference between the BEHAVIOUR of the experimental group and the BEHAVIOUR of the control group, indicating the duration of the scenario blocks applied, and providing information on the nature of the used planning models.

	BEHAVIOUR TA			BEHAVIOUR TB		
Scenario	Block	No. of Ques.	Time Allowed	Block	No. of Ques.	Time Allowed
	1	5	3 min	1	5	3 min
	2	5	5 min	2	5	N/a
	3	7	10 min	3	7	10 min
	4	5	12 min	4	5	12 min

TABLE 4.2: DIFFERENCE BETWEEN BEHAVIOURS

DEPENDENT VARIABLES

The dependent variables DV1, DV2, DV3, and DV4 are determined by analysing data collected through questionnaires that all learners have to fill in, the first time during the pre-training test, and the second time during the post-training test.

The categories of the questionnaire are as follows:

- DV1 (Interest): Questions about personal interest in learning more about software project management.
- DV2 (Knowledge): Questions about typical performance patterns of software projects. These questions are based on some of the empirical findings and lessons learnt summarized in Barry Boehm's top 10 list of software metric relations [62].

DV3 (Understanding simple dynamics): Questions on project planning problems that require simple application of the provided process management models, addressing trade-off effects between no more than two model variables.

- DV4 (Understand complex): Questions on project planning problems addressing trade-off effects between more than two variables, and questions on planning problems that may require re-planning due to alterations of project constraints (e.g. reduced manpower availability, shortened schedule, or changed requirements) during project performance.

DISTURBING FACTORS

The values of the three potentially disturbing factors DF1, DF2, and DF3 are also derived from questionnaires that all learners have to fill in. The questionnaire for DF1 will be filled in before the pre-training test, and the questionnaires for DF2 and DF3 will be filled in after the post-training test.

The contents of the questionnaires are as follows:

- DF1: Questions about personal characteristics (age, gender), university education (year, major, minor), software development practical experience, background on software project management literature, and preferred learning style.
- DF2: Questions on actual time consumption per scenario block and on perceived time needed.
- DF3: Questions on personal judgment of the training session (subjective session evaluation).
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EXPERIMENTAL PROCEDURE

The experiment was conducted following the plan presented in table 4.3. After a short introduction during which the purpose of the experiment and general organisational issues were explained, data on the background characteristics (variable DF1) was collected with the help of a questionnaire. Then the pre-training test was conducted and data on all dependent variables (DV1 to DV4) was collected, using questionnaire. Following the pre-training test, a brief introduction of organisational issues related to the 'behaviour' was given. After that, the learners were randomly assigned either the experimental or control group. Then each group underwent its specific 'behaviour'. After having concluded their 'behaviour', both groups passed the post-training test using the same set of questionnaires as during the pre-training test, thus providing data on the dependent variables for the second time. Finally, the learners got the chance to evaluate the training session by filling in another questionnaire, providing data on variables DF2 and DF3. The time frames reserved for passing a certain step of the schedule was identical for the experimental as well as control groups.

Introduction to experiment	5 min
Background characteristics	5 min
Pre-training test • Interest • Knowledge about empirical patterns • Understanding of simple project dynamics • Understanding of complex project dynamics	 3 min 5 min 10 min 12 min
Introduction to BEHAVIOURs	5 min
Random assignment of learners to groups	5 Min
BEHAVIOUR	45 min
Post-training test • Interest • Knowledge about empirical patterns • Understanding of simple project dynamics • Understanding of complex project dynamics	 3 min 5 min 10 min 12 min
Time need & subjective session evaluation	5 min
Total	130 min

TABLE 4.3: SCHEDULE OF EXPERIMENT

The experiment was performed on two days following the schedule presented in table 4.3. On the first day, the steps "Introduction to experiment", "Background characteristics", and "Pre-training test" were conducted, consuming a total of 40 minutes. On the second day, the steps "Introduction to 'behaviour', "Random assignment of learners to groups", 'behaviour', "Post-training test", and "Time need & subjective session evaluation" were conducted, consuming a total of 90 minutes. Of the 12 learners that agreed to participate in the experiment, 9 learners participated in both pre-training test and post-training test. 5 learners were assigned randomly to the experimental group (A), and 4 to the control group (B).

DATA COLLECTION PROCEDURE

The raw data for dependent variables DV1 to DV4 are collected during pre-training test and post-training test with the help of questionnaires.

The values for variable DV1 ("Interest") are average scores derived from five questions on the learner's opinion about the importance of software project management issues a) during university education, and b) during performance of industrial software development projects, applying a five-point Likert-type scale. Each answer in the questionnaire is mapped to the value range R = [0, 1] assuming equidistant distances between possible answers, i.e. "fully disagree" is encoded as "0", "disagree" as "0.25", "undecided" as "0.5", "agree" as "0.75", and "fully agree" as "1".

All questions were formulated in a way that positive attitude towards project management education and application of project management techniques in projects must be expressed by ticking the fields "agree" or "fully agree". The values for variables DV2 ("Knowledge"), DV3 ("Understand simple"), and DV4 ("Understand complex") are average scores derived from five questions from DV1, five for DV2, seven for DV3 and six questions for DV4) questions in multiple choice style. The answers to these questions were evaluated according to their correctness, thus having a binary scale with correct answers encoded as "1", and incorrect answers encoded as "0". The raw data for disturbing factors DF1 to DF3 were collected before pre-training test (DF1) and after post-training test (DF2 and DF3).

4.4.2 DATA ANALYSIS PROCEDURE

The conceptual model underlying the proposed statistical analysis is summarized in figure 4.1. It is inspired by the work of Jac Vennix who conducted a similar experiment, assuming that there are two separate effects on the dependent variables. In the first step, the statistical analysis applies a t-test to investigate the effect of the independent variable on the dependent variables. For testing alternative hypothesis H1, a one-way paired t-test can be used, because the data collected for this hypothesis is within-learners, i.e. post-training test scores are compared to pre-training test scores of learners within the same group. For testing hypotheses H2 and H3, repeated measures analysis could not be applied. Thus the appropriate test was a one-sided t-test for independent samples, or, equivalently, a single factor.

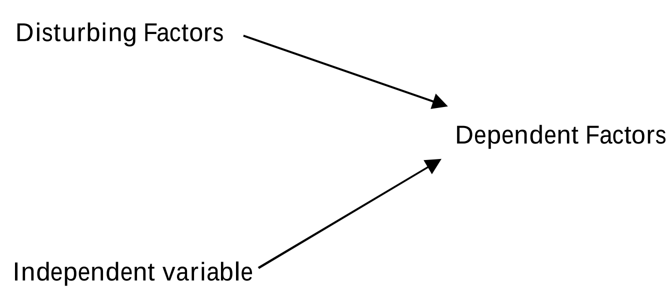

FIGURE 4.1: RELATIONSHIP BETWEEN EXPERIMENTAL VARIABLES

In addition to that, for testing hypotheses H2 and H3, analysis of covariance (ANCOVA) can be applied to improve the precision of the statistical analysis by removing potential bias due to disturbing factors. To conduct the analysis, a level of significance, i.e., the α-level, has to be specified. Several factors have to be considered when setting α-level. First, the implications of committing a Type '1' error, i.e., incorrectly rejecting the true Null Hypothesis H0,4.1, have to be determined. On the basis of the data shown in table 4.4 and table 4.5, we accept the Null Hypothesis H0,4.1 to be true which would mean building and using simulation models in learner education without achieving any beneficial effect as compared to using conventional planning models. Secondly, the following goals of the study have to be taken into account:

- From a practical perspective, i.e. asking for a judgment on whether it is likely that using SD simulation models for training has a better learning effect than using traditional planning models.
- From a scientific perspective, i.e. trying to identify cause-effect relationships between the type of the used planning model and the learning effect, with a high level of confidence.

TABLE 4.4: PRE-TRAINING TEST MEAN, MEDIAN, AND STANDARD DEVIATION

As previously stated, the empirical work presented in this paper should be considered as exploratory research whose goals are twofold: Firstly, potentially interesting and practically significant trends shall be identified in order to focus future studies and secondly, initial insights into what might be the consequences of using SD simulation models for learner education shall be gained. Therefore, not a too stringent α level should be adopted, since this might result in overlooking potential areas of further investigation. In the study presented, α = 0.1 was used. This can be seen as a compromise between a more practical perspective, and a strictly scientific perspective.

Another factor affecting the analysis procedure is the small sample sizes, which are likely to have an adverse effect on the power of the applied statistical methods; i.e. by chance that if any effect exists, it will be found out. The power of a statistical test is dependent on three different components: significance of level α, the size of the effect being investigated, and the number of learners. Low power will have to be considered while interpreting non-significant results.

DEPENDENT VARIABLE: PRE-TRAINING TEST SCORES				
GROUP A	**DV1**	**DV2**	**DV3**	**DV4**
Learner #1	0.75	1	0.29	0.33
Learner #2	0.9	0.4	0	0
Learner #3	0.5	0.6	0.71	0.5
Learner #4	0.8	0.2	0.29	0.67
Learner #5	0.5	0.6	0.29	0.33
Meanpre-training test	0.69	0.56	0.31	0.37
Medianpre-training test	0.75	0.6	0.29	0.33
Stdevpre-training test	0.18	0.30	0.26	0.25
Group B	DV1	DV2	DV3	DV4
Learner #6	1	0.2	0.14	0.67
Learner #7	0.8	0.8	0.29	0.17
Learner #8	0.75	0.6	0.43	0.33
Learner #9	0.7	0.4	0.86	0.17
Meanpre-training test	0.81	0.5	0.43	0.33
Medianpre-training test	0.78	0.5	0.36	0.25
Stdevpre-training test	0.7	0.26	0.31	0.24

DEPENDENT VARIABLE: POST-TRAINING TEST SCORES				
GROUP A	**DV1**	**DV2**	**DV3**	**DV4**
Learner #1	0.85	0.8	0.43	0.33
Learner #2	1	1	0.71	0
Learner #3	0.5	1	0.71	0.33
Learner #4	0.85	0.8	0.71	0.83
Learner #5	0.75	0.6	0.71	0.67
Meanpost-training test	0.79	0.84	0.66	0.43
Medianpost-training test	0.85	0.80	0.71	0.33
Stdevpost-training test	0.19	0.17	0.7	0.32
Group B	DV1	DV2	DV3	DV4
Learner #6	1	0.6	0.86	0.83
Learner #7	0.85	0.6	0.86	0.33
Learner #8	0.75	0.4	0.86	0
Learner #9	0.55	0.8	0.71	0.67
Meanpost-training test	0.79	0.6	0.82	0.46
Medianpost-training test	0.80	0.60	0.86	0.50
Stdevpost-training test	0.19	0.16	0.07	0.37

Table 4.5: Post-Training Test Mean, Median, and Standard Deviation

These cases of practical significance need to be considered. Practical significance occurs when the effect being investigated impacts upon the dependent variables in a manner that can be considered practically meaningful. To determine if this is the case, the observed effect size (γ) detected for each dependent variable and for each hypothesis has to be calculated.

Effect size is expressed as the difference between the means of the two samples divided by the root mean square of the variances of the two samples. For this exploratory study, the effects are $\gamma \geq 0.5$, have been considered to be of practical significance.

Dependent Variable: Differences Scores				
Group A	**DV1**	**DV2**	**DV3**	**DV4**
Learner #1	0.10	0.20	0.14	0
Learner #2	0.10	0.60	0.71	0
Learner #3	0	0.40	0	0.17
Learner #4	0.05	0.60	0.43	0.17
Learner #5	0.25	0	0.43	0.33
Meandifference	0.10	0.28	0.34	0.07
Mediandifference	0.10	0.40	0.43	0.00
Stdevdifference	0.09	0.36	0.28	0.19
Group B	DV1	DV2	DV3	DV4
Learner #6	0	0.40	0.71	0.17
Learner #7	0.05	0.20	0.57	0.17
Learner #8	0	0.20	0.43	0.33
Learner #9	0.15	0.40	0.14	0.50
Meandifference	0.03	0.10	0.39	0.7
Mediandifference	0.00	0.10	0.50	0.17
$\text{Stdev}_{\text{difference}}$	**0.09**	**0.35**	**0.38**	**0.34**

Table 4.6: Differences between the Scores of Pre-Training Test and Post-Training Test

4.4.3 Experimental Results

Data was collected for nine learners during pre-training test and post-training test. Therefore, 18 data points were available for each dependent variable and each disturbing factor – 10 data points provided by the experimental group (group A), and eight data points provided by the control group (group B). Table 4.4 and Table 4.5 show the raw data collected during pre-training test and post-training test together with the calculated values for mean, median, and standard deviation.

Table 4.6 shows the differences between post-training test and pre-training test scores together with the calculated values for mean, median, and standard deviation.

Disturbing Factors					
Group A	**DF1**	**DF2**	**DF2´**	**DF3**	**DF3´**
Learner #1	0.4	0.8	0.67	0.44	0.52
Learner #2	0.6	0.4	0.33	0.56	0.46
Learner #3	0.4	0	0	0.38	0.54
Learner #4	0.8	0	0	0.38	0.48
Learner #5	0.2	1	1	0.31	0.5
Meanddif	0.48	0.44	0.4	0.41	**0.5**
Mediandif	0.4	0.4	0.33	0.38	**0.5**
Stdevdif	0.23	0.46	0.43	0.09	**0.03**
Group B	DF1	DF2		DF3	
Learner #6	0.8	0.2		0.69	
Learner #7	0.4	0.2		0.56	
Learner #8	0.4	0.6		0.69	
Learner #9	0.8	0.4		0.69	
Meandif	0.6	0.35		0.66	
Mediandif	0.6	0.3		0.69	
Stdevdif	0.23	0.19		0.06	

Table 4.7: Mean, Median, and Standard Deviation Disturbing Factors

Table 4.7 shows the data collected for the disturbing factors together with the calculated values for mean, median, and standard deviation. As can be seen, learners in the control group (group B) on average had more experience with software development (DF1) than those in the experimental group (group A).

In addition, learners in the control group expressed less need of additional time (DF2) for conducting the ‘behaviour’ and passing the tests than these in the experimental group. Finally, learners in the control group on average perceived their ‘behaviour’ easier, clearer, more absorbing, and more useful (DF3) than those in the experimental group. Therefore, H0,4.2 is rejected.

ANALYSIS SUMMARY

The results of the statistical analysis can be grouped according to the degree of evidence in supporting the hypotheses. Three categories have been defined: strong support, i.e. the data shows statistical significance (at α level 0.10), weak support, i.e. the data shows practical significance ($\gamma \geq 0.5$), and no support, i.e. the data has neither statistical nor practical significance.

Strong Support: Statistical and practical significance was obtained for variables DV1 (only group A), DV2 (only group A), and DV3 (group A and group B) in support of alternative hypothesis H1 – "post-training test scores versus pre-training test scores". After elimination of disturbing factors, statistical and practical significance in support of alternative hypothesis H2 – "performance improvement" – and of alternative hypothesis H3 – "post-training test performance" – was only obtained for variable DV2 ("Knowledge of empirical patterns").

Weak Support: Practical significance was obtained for variable DV1 (Interest) in support of alternative hypothesis H2 – "performance improvement" – and of alternative hypothesis H3 – "post-training test performance". For alternative hypothesis H2, impact on variable DV1 is even statistically significant, if only the results of the Table 4.11 are considered.

No Support: No practical significance was found for variable DV 4 ("Understanding of complex project dynamics") in all three alternative hypotheses H1, H2, and H3, and for variable DV3 ("Understanding of simple project dynamics") in alternative hypotheses H2 and H3.

RELIABILITY

Reliability is the degree to which the results of a measurement reflect the true score of the intended concept, e.g. "Interest in software project management issues". Reliability would be low if measurement results, e.g. the response to an item in a questionnaire, mainly reflect some esoteric, random error that is due to differences between learners as to how they read and understand a particular question in the questionnaire. With regard to variable DV1 ("Interest") sufficient reliability can be assumed because the questionnaire used is composed of questions that have been used successfully in a previous experiment. The measures of variables DV2 to DV4 were collected by objective measurement, i.e. each question has exactly one correct answer. Therefore, reliability of the related measurement results can be assumed.

CONCLUSION AND DISCUSSION OF RESULTS

In this research paper, we investigated the effect of using the model in software project management education on the behaviour of Computer Science and Software Engineering learners. The 'BEHAVIOUR' focused on the problems of project planning and control. The performance of the learners is analyzed with regard to four dimensions, i.e., interest in the topic of project management (DV1), knowledge of typical project behaviour patterns (DV2), understanding of simple project dynamics (DV3), and understanding of complex project dynamics (DV4). The learners were made to go through a training session on SESeLE, their responses on these dimensions were gathered before and after the training and then both sets of responses of individual learners were compared. Even though the statistical results must be interpreted with caution due to a) small number of learners involved and b) several threats to internal validity; the findings of the analyses shows several interesting trends. Therefore, we can say that to enhance the BEHAVIOURs, two issues are relevant. First, more time has to be allowed particularly for executing scenario blocks, and for the familiarization with the simulation tool. Second, the experimental BEHAVIOUR, as it is, does not yet fully exploit all potentially available features of a learning tool that SDM usage and model building can offer.

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