

# **A new automated method of e-learner's satisfaction measurement**

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**Key words:** *Tele-learning, m-learning, non-linear learning, multi-tasking evaluation, ambient usability, quality assessment, human-computer interaction*

## **Abstract:**

*This paper presents a new method of measuring learner's satisfaction while using electronic learning materials (e-courses, edutainment games, etc.) in virtual non-linear environments. Method is based on a relation of Discovering and Learning probability distribution curves obtained by collecting and evaluating the human-computer interaction data. While being near real-time, this measurement is considered highly unobtrusive and cost-effective because of its automated approach.*

*The first working prototype EDUSA 1.0 was developed and successfully tested by the Distance Education Studies Centre of Riga Technical University.*

## **1 Definition of learner's satisfaction**

ISO 9241-11 (1998) *Guidance of Usability* standard defines satisfaction as one of the core components of the product usability assessment. Nielsen and Shneiderman [1, 2] describe subjective satisfaction as a part of "usefulness" in a framework of system acceptability.

According to Keller [7] satisfaction relates to perceptions of being able to achieve success and feelings about the achieved outcomes. From this perspective, several studies have explored student satisfaction with online learning materials [8, 9, 10, 11].

## **2 Learner's satisfaction assessment methods**

### **2.1 Non-automated satisfaction measurement**

Johnson et al indicate that studies of learner satisfaction are typically limited to one-dimensional post-training perceptions of learners. Learner's satisfaction is too often measured with "happy sheets" that ask learners to rate how satisfied they were with their overall learning experience [6].

Harrison, Seeman et al. [12] identified four major components of effectiveness in distance education programs: instruction, management, telecommuting, and support. Within each of these broad categories are two to five subcomponents.

Jegede et al. described another example of a validated approach to assessing a deeper degree of satisfaction identifying eight components of effective learning environments: interactivity, institutional support, task orientation, teacher support, negotiation, flexibility, technological support, and ergonomics. By building on these valid and reliable measures of effective learning environments, a more significant assessment of learner satisfaction and outcomes can be obtained [13].

## 2.2 Automated satisfaction measurement

According to the literature there have been very few attempts or in very strictly defined environments (e.g. MS Word) started until now to develop methods of truly automated system-wide evaluation of learner's satisfaction. In order to perform a satisfaction measurement of today's technology-savvy non-linear [5] learner, a holistic automated measurement approach is required.

## 2.3 Browsing, Discovering and Learning probability distributions

2005 Distance Education Studies Centre at Riga Technical University started a research project based on earlier defined concepts of E-Gestures and Good Content Indicators [3, 4] and developed a first working prototype (called EDUSA 1.0) with the functionality of automated measurement of learner's satisfaction. 2006 the research area was extended by adding EDUSA tests for m-learning within the scope of 'PUMPURS' project (VPD1/ERAF/CFLA/05/APK/2.5.1./000078/038).

First experimental data gathered from 11 man/days and 60 test participants revealed the presence of two characteristic probability distributions that were called Discovering and Learning curves. The third component - Browsing curve - was later added to complete the model.

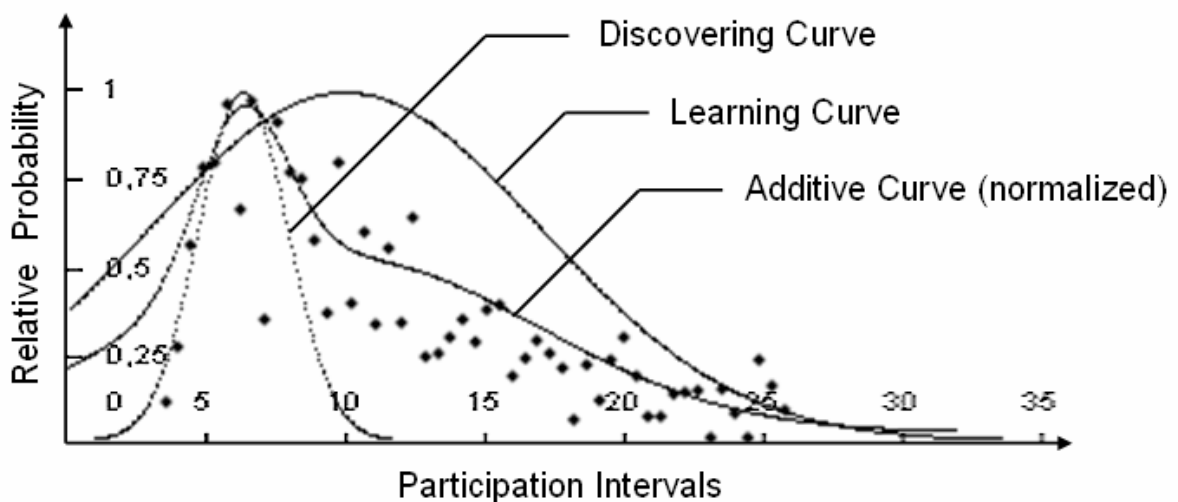


Figure 1 Discovering and Learning curves according to the EDUSA-Model

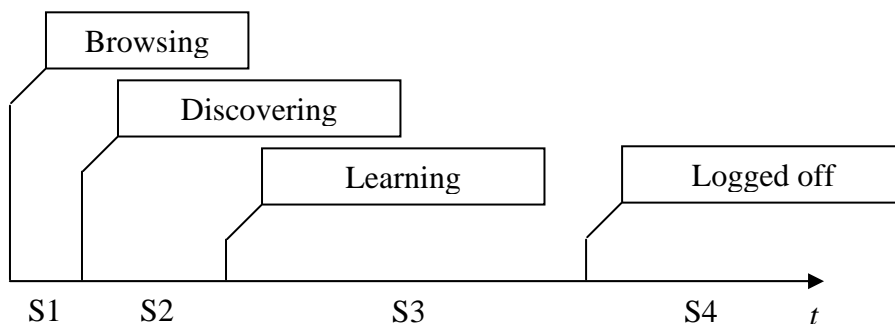
## 2.4 Discovering/Learning Behaviour Assessment

EDUSA-Test emphasizes the organic and functional relation between all parts (tasks) and the whole system (in broader sense – human, computer and surrounding ambience). It acts task independently at the very core of the operational system. It connects to the human-computer interface to scan all the communication between user and system. The resulting information is searched for programmatically recognizable patterns of human behaviour (e-gestures) and used to identify learner’s subjective satisfaction with the learning material. Optionally EDUSA can build and export learner’s profile that can be later used with other multi-tasking evaluation sessions.

During the testing session EDUSA writes every task-related action to a XML log file. This way it can handle both continued and discontinued learning sessions while analyzing the recorded data subsequently. EDUSA has the ability to reconstruct discontinued learning tasks and analyze them by putting in different evaluation contexts (task scopes, e-gesture sets, etc.). EDUSA is aware of all learner-computer interactions provided by the interface. This allows evaluation of both linear and non-linear learning sessions.

To examine the user behaviour/satisfaction patterns, EDUSA-Tests with two different e-learning product categories were made: an eLearning course represented by the eCourse *SQL Fundamentals* and online game represented by *Marketplace* game.

Results available after the automated data analysis included: (1) a reference user activity index, (2) a per-cent deviation between user data and calculated curve, (3) a per-cent relation between Browsing, Discovering and Learning (BDL) integral values, (4) time points of BDL curve maximum occurrences and (5) width values for the BDL curves.



**Figure 2** Browsing/Discovering/Learning (BDL) time slots

Figure 2 shows the time slots according to the EDUSA BDL model. In the reality these time slots are almost never strictly separated, but rather constitute an overlapping 3-curve (Browsing, Discovering and Learning curves) system that can be effectively separated and analysed by the system.

### 2.4.1 EDUSA-Test for eCourse

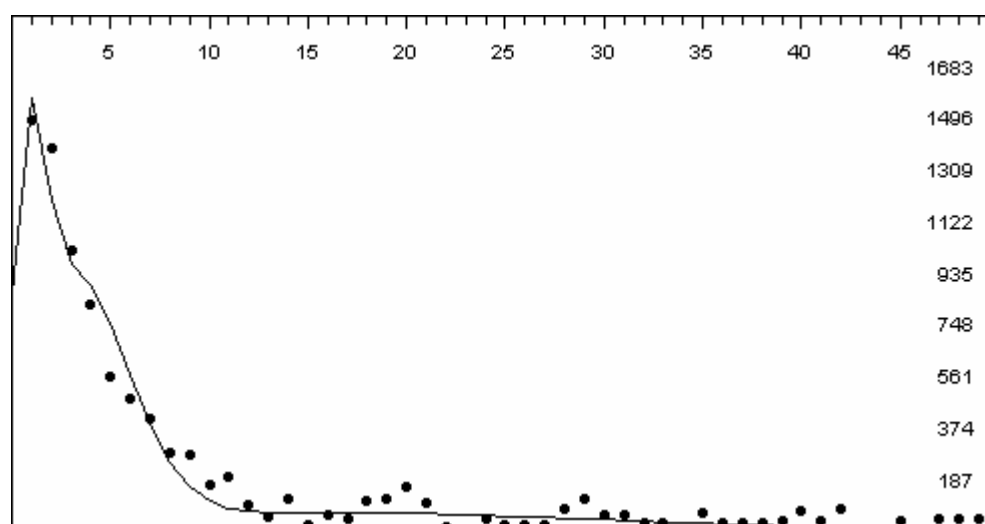


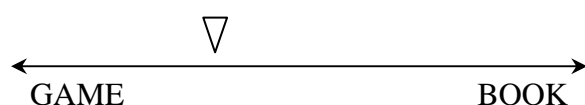
Figure 3 Game-like Discovering/Learning behaviour

<b>Subject</b>	e-Course: SQL Fundamentals
<b>Session</b>	20051125 Liepaja
<b>Profile</b>	Group 1
<b>Duration</b>	3 hours
<b>Activity</b>	9602
<b>Deviation</b>	4,8%

EDUSA-Test parameters (SQL/Liepaja/1)

	<b>Browsing</b>	<b>Discovering</b>	<b>Learning</b>
<b>Weight</b>	15,05%	59,27%	25,68%
<b>Max at</b>	1s	3s	15s
<b>Max</b>	823,9	898,8	74,9
<b>Width</b>	1	0,06	0

EDUSA-Test results (SQL/ Liepaja /1)



Game-Book Index (GBI) calculated using EDUSA-Test for SQL/Liepaja/1

EDUSA-Test shows that this particular target group (one or more users) has treated the subject learning material more game-like than book-like.

If the intention of the particular eContent creator was to develop a game-like eLearning product, then the target group can be considered as satisfied with the product at 59,27%.

### 2.4.2 EDUSA-Test for eGame (1)

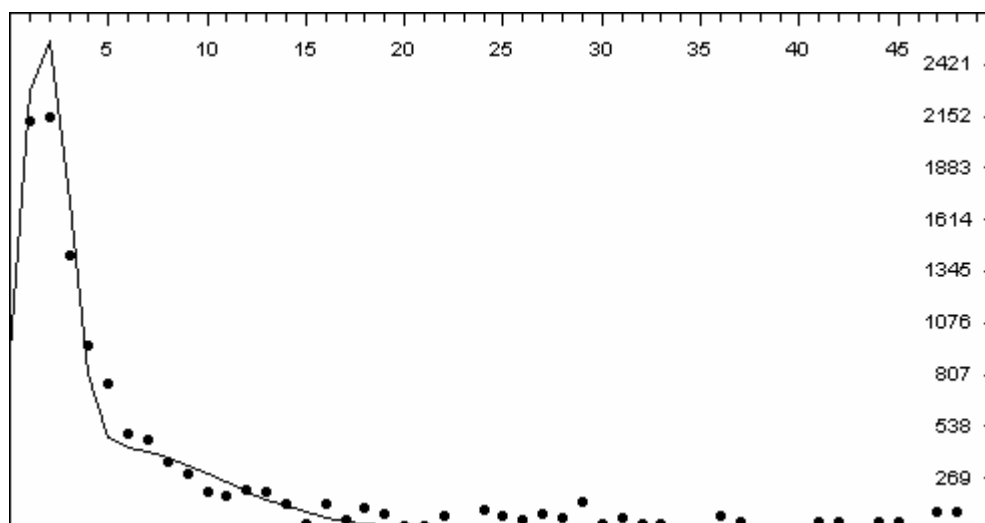


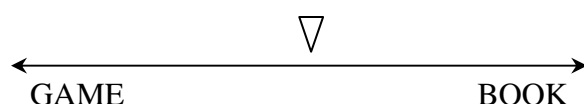
Figure 4 Neutral Discovering/Learning behaviour

<b>Subject</b>	e-Game: Marketplace
<b>Session</b>	20060626 Dikli
<b>Profile</b>	Group A
<b>Duration</b>	3 hours
<b>Activity</b>	11594
<b>Deviation</b>	2,02%

EDUSA-Test parameters (SQL/Dikli/A)

	<b>Browsing</b>	<b>Discovering</b>	<b>Learning</b>
<b>Weight</b>	9,76%	46,32%	43,93%
<b>Max at</b>	1s	2s	5s
<b>Max</b>	645,3	1935,9	430,2
<b>Width</b>	1	0,4	0,02

EDUSA-Test results (SQL/Dikli/A)



Game-Book Index (GBI) calculated using EDUSA-Test for SQL/Dikli/A

EDUSA-Test shows that this particular target group (one or more users) has treated the subject learning material partially game-like and partially book-like (neutral Discovering/Learning behaviour).

If the intention of the particular eContent creator was to develop an eLearning product with both the game and the book user behaviour components, then the target group can be considered as satisfied with the product at 90,25%.

### 2.4.3 EDUSA-Test for eGame (2)

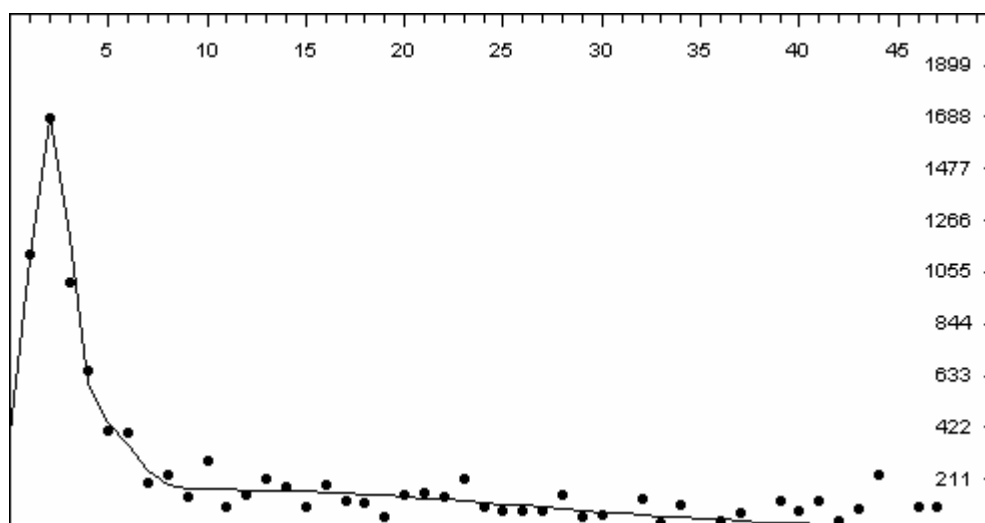


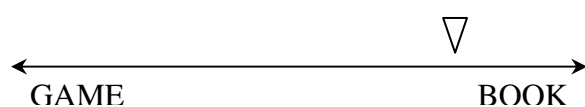
Figure 5 Book-like Discovering/Learning behaviour

<b>Subject</b>	e-Game: Marketplace
<b>Session</b>	20060626 Dikli
<b>Profile</b>	Group F
<b>Duration</b>	3 hours
<b>Activity</b>	9794
<b>Deviation</b>	1,61%

EDUSA-Test parameters (SQL/Dikli/F)

	<b>Browsing</b>	<b>Discovering</b>	<b>Learning</b>
<b>Weight</b>	40,66%	8,34%	51%
<b>Max at</b>	2s	5s	10s
<b>Max</b>	1517,4	252,9	168,6
<b>Width</b>	0,45	0,3	0

EDUSA-Test results (SQL/Dikli/F)



Game-Book Index (GBI) calculated using EDUSA-Test for SQL/Dikli/F

EDUSA-Test shows that this particular target group (one or more users) has treated the subject learning material more book-like than game-like.

If the intention of the particular eContent creator was to develop a book-like eLearning product, then the target group can be considered as satisfied with the product at 51,00%.

### **3 Application scenarios of learner's satisfaction measurement method**

Learner's satisfaction measurement can be applied to various types of electronic learning content packages including learning objects, e-courses and edutainment games.

#### **3.1 E-content target group determination**

A consolidated target group value can be calculated for a specified eLearning product in order to determine a probability of satisfaction distribution within specific target groups of learners, e.g.: students with specific age, gender, skills, etc.

#### **3.2 E-content product categorization**

Electronic learning materials can be categorized using EDUSA model in Game-like and Book-like products. The stronger the component of Discovering within the EDUSA measurement, the greater is the probability that product is Game-like. The same is true also for the Learning component and Book-like products.

### **4 Conclusion**

The new method of e-learner's satisfaction measurement with its high degree of unobtrusiveness and cost-effectiveness can support industry of developers and producers of electronic learning materials (e-courses, edutainment games, etc.) in efficient, early and automated usability assessment offering new possibilities to better adjusting learning products to the needs of specific target groups and learning context requirements.

According to the EDUSA-Test results target groups can be considered as satisfied or unsatisfied with the certain component category of the electronic learning material if the intention of the content producer corresponds to the treatment pattern of the user.

The automatically measured Game-Like vs. Book-Like material treatment by the user can be substantially valuable for the electronic content producers to better determine target group markets for the new and/or existing eLearning products.

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