

# **Automated satisfaction measurement for e-learning target group identification**

*Armands Strazds, Atis Kapenieks*

Riga Technical University Distance Education Studies Centre / Latvia

**Key words:** *Computer aided learning, e-learning, non-linear learning, multi-tasking evaluation, ambient usability, quality assessment, human-computer interaction, EDUSA-Test, Island of Comfort*

## **Abstract:**

*This paper describes a new approach of how an automated satisfaction measurement method can be used to identify and index target groups of various e-learning materials (e.g. e-courses, edutainment games, etc.). The proposed approach is based on a method developed by the Distance Education Study Centre at Riga Technical University describing the relation between 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 highly automated approach.*

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

ISO [1] standard defines satisfaction as one of the core components of the product usability assessment. Nielsen and Shneiderman [2, 3] describe subjective satisfaction as a part of "usefulness" in a framework of system acceptability.

According to Keller [8] 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 [9, 10, 11, 12].

## **2 The assessment method of e-learning target group satisfaction**

### **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 [7].

Harrison, Seeman et al. [13] 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 [14].

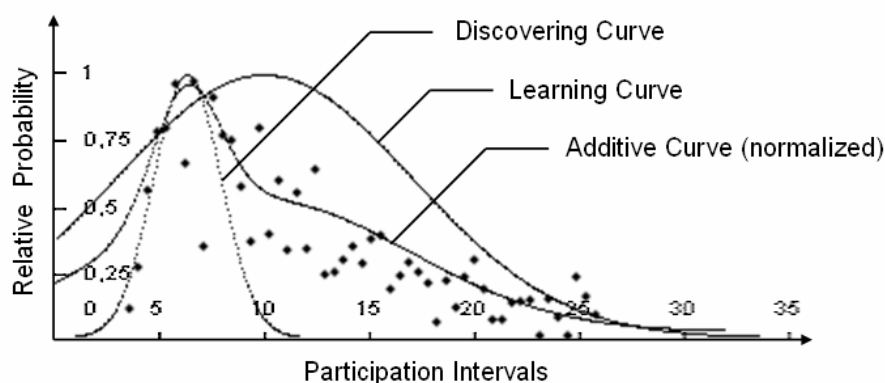
## 2.2 Automated satisfaction measurement

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 [6] learner, a holistic automated measurement approach is required.

## 2.3 Browsing, Discovering and Learning probability distributions

2005 Distance Education Study Centre at Riga Technical University started a research project based on earlier defined concepts of E-Gestures and Good Content Indicators [4, 5] 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 normal distributions of probability 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

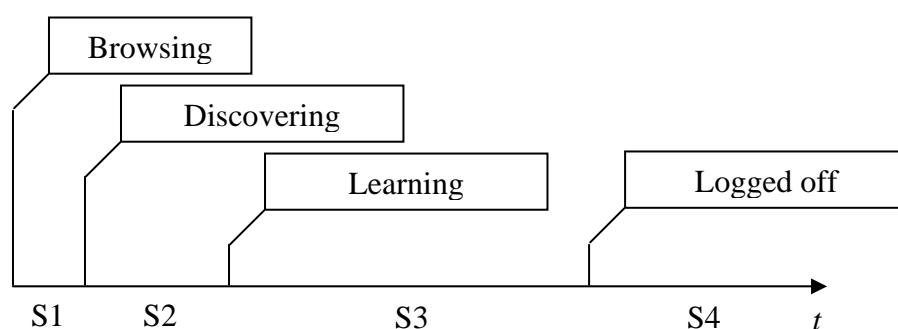
## 2.4 Discovering/Learning Behaviour Assessment

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.

## 2.5 The EDUSA-Test

EDUSA-Test measures learner's participation events (keyboard, mouse behaviour, etc.) frequency during the given learning session.

The collected data is analysed using the smallest-squares-method with the purpose to find the first three normal distribution curves (Browsing, Discovering and Learning curves) that best fit to describe the data. After this, area below each of the curves is calculated and normalized as a relation to the range 0..100.

The resulting output is represented as a location on a ternary diagram with all the three components: Browsing, Discovering and Learning on its axis.

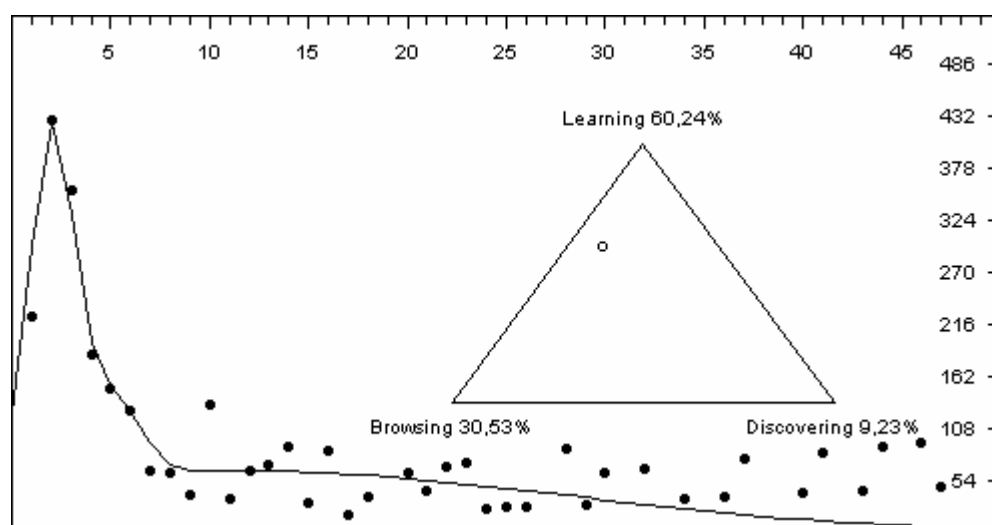
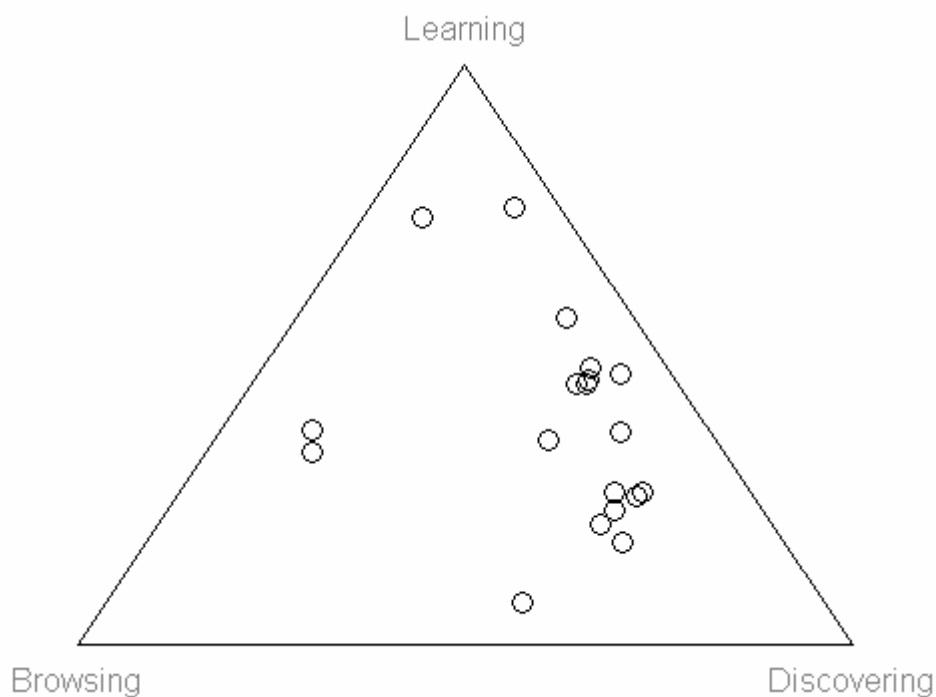


Figure 3 EDUSA-Test results representation

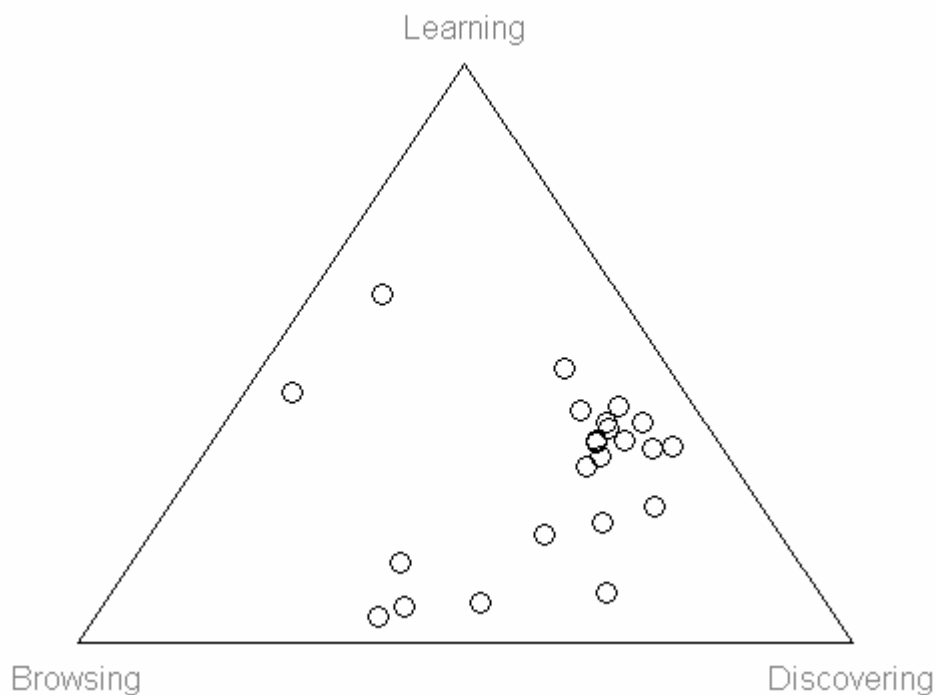
<b>Subject</b>	e-Game: Marketplace
<b>Session</b>	20060626 Dikli
<b>Profile</b>	Group F / Quarter 2
<b>Duration</b>	1,5 hours (26.06.2006 18:30 – 20:00)
<b>Activity</b>	3315
<b>Deviation</b>	10,29%

	<b>Browsing</b>	<b>Discovering</b>	<b>Learning</b>
<b>Weight</b>	30,53%	9,23%	60,24%
<b>Max at</b>	2s	5s	12s
<b>Max</b>	364,65	85,8	64,35
<b>Width</b>	0,4	0,25	0,001

## 2.6 EDUSA session results representation



**Figure 4** Ternary diagram of EDUSA session for e-Course *SQL Fundamentals*



**Figure 5** Ternary diagram of EDUSA session for e-Game *Marketplace*

Ternary diagrams of EDUSA-Test results show the presence of “participation islands” (called also Islands of Comfort). It was observed that better learning results can achieve those learners who are able to “leave” the Islands of Comfort, in other words: an important learning strategy is to vary the learner’s participation (Browsing/Discovering/Learning) styles.

### **3 Application scenarios of e-learning target group 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**

1. The results of EDUSA-Test show the presence of "Island" ("Island of Comfort") around the middle range of Discovering/Learning axis;
2. Those learners who are able to leave the Island of Comfort (show the explicitly different and varying learning style) can achieve better learning results.

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.

## References:

- [1] ISO 9241-11 (1998) *Guidance of Usability*
- [2] Nielsen, J.: *Usability Engineering*, Morgan Kaufmann Publishers, ISBN 0-12-518406-9, 1994
- [3] Shneiderman, B.: *Software Psychology*, 1980
- [4] Strazds A., Kapenieks A. et al.: *Piloting of EDUSA in non-linear multimedia learning environments*, Conference on Interactive computer aided learning (ICL 2006), Villach, Austria, September 26 - 28, 2006, CD-ROM, ISBN 3-89958-195-4, Kassel University Press, 2006
- [5] Strazds A.: *m-Learning evaluation - a multi-tasking approach*, Conference on Interactive Mobile and Computer Aided Learning (IMCL 2006), Amman, Jordan, April 19 - 21, 2006, CD-ROM, ISBN 3-899958-177-6, Kassel University Press, 2006
- [6] Veen, W.: *Teaching the media generation, Coping with Homo Zappiens*, 2006
- [7] Johnson, S.D., Aragon, S.R. et al.: *Comparative Analysis of Learner Satisfaction and Learning Outcomes in Online and Face-to-Face Learning Environments*, *Journal of Interactive Learning Research* 11(1), 29-49, 2000
- [8] Keller, J.: *Motivational design of instruction*. In C. Reigeluth (Ed.), *Instructional design theories and models: An overview of their current status* (pp. 386-434). Hillsdale, NJ: Erlbaum, 1983
- [9] Debourgh, G.A.: *Learner and instructional predictors of student satisfaction in a graduate nursing program taught via interactive video conferencing and world wide web/internet*. Unpublished doctoral dissertation, University of San Francisco, 1989
- [10] Enockson, J.: *An assessment of an emerging technological delivery for distance education*. Doctoral dissertation, Northern Arizona University, 1997
- [11] Johanson, T.L.: *The virtual community of an online classroom: Participant's interactions in a community college writing class by computer mediated communication*. Doctoral dissertation, Oregon State University, 1996
- [12] McCabe, M.: *Online classrooms: Case studies of computer conferencing in higher education*. Doctoral dissertation, Columbia University Teachers College, 1997
- [13] Harrison, P.J., Seeman, B.J., et al.: *Development of a distance education assessment instrument*. *Educational Technology Research & Development*, 39(4), 65-77, 1991
- [14] Jegede, O.J., Fraser, B., Curtin, D.F.: *The development and validation of a distance and open learning environment scale*. *Educational Technology Research & Development*, 43(1), 90-94, 1995

## Authors:

Armands Strazds, M. A.  
Riga Technical University, Distance Education Study Centre  
Azenes 12, Riga  
strazds@gmail.com

Atis Kapenieks, Dr. Phys.  
Riga Technical University, Distance Education Study Centre  
Azenes 12, Riga  
desc@rsf.rtu.lv