Test based sequecing in scorm compliant e-learning courses

Jurgita Lieponienė[1,2], Regina Kulvietienė[1]

[1] *Vilnius Gediminas Technical University*
  Saulėtekio Ave. 11, LT-10223 Vilnius

[2] *Panevėžys College*
  Laisvės Sq. 23, LT-35200 Panevėžys
  E-mail: jurgita-lieponiene@panko.lt; regina_kulvietiene@gama.vtu.lt

Abstract. The article analyzes the importance of assessment feedback in e-learning, analyzes test based sequencing possibilities in SCORM compliant e-learning courses. The article assesses if learning management systems such as Moodle, ATutor, and Workplace Collaboration Learning System support the SCORM 2004 sequencing specification.

Keywords: feedback, SCORM, test.

1 Introduction

Knowledge assessment is an integral part of learning process. Assessment feedback helps a student to identify mistakes, to improve knowledge, to seek higher results. This factor is especially important for e-learning where a direct communication between a lecturer and a student is replaced with a virtual one.

E-learning is presently becoming very popular, so different e-learning standards are prepared and implemented. SCORM is one of the most popular and commonly used sets of specifications and standards intended for the standardization of e-learning content [7, 5, 8]. The most recent version of SCORM, SCORM 2004, integrates IMS Simple Sequencing specification that allows the course creator to include learning content sequencing information [5]. In SCORM courses tests provide students with feedback on their current level of achievement. They also can be used for course content sequencing and the learners with different abilities can be provided with different learning paths.

SCORM based courses can be delivered and tracked by different SCORM compliant learning management systems. The aim of the article: to review the importance of assessment feedback in e-learning, to explore test based sequencing possibilities in SCORM compliant e-learning courses and to assess the compatibility of learning management systems used in Lithuania: Moodle, ATutor, and Workplace Collaboration Learning System with SCORM 2004 specifications.

2 Assessment feedback in e-learning

Feedback in e-learning is the mechanism that tends to replace a teacher who provides comments, advice, and explanations and evaluates the students within traditional

learning environments [15]. Assessment feedback is one of feedback types that the students receive during the assessment. Different kinds of assessment are used in e-learning courses. Formative assessment refers to assessment that is specifically intended to generate feedback on performance to improve and accelerate learning [6]. According to D.J. Nicol and D. Macfarlane-Dick formative assessment and feedback should be used to empower students as self-regulated learners.

The importance of feedback in e-learning is emphasized by many authors. A. Bischoff points out that students need regular feedback in order to know how their performance has been evaluated, and how they can improve it, and also how their grades are calculated [3]. G. Rodriguez Gomez et al. emphasize that not any assessment feedback can be considered as qualitative feedback [11]. Literature offers various criteria specifying qualitative feedback. According to D.J. Nicol and D. Macfarlane-Dick feedback is qualitative if it: relates to set criteria of which the student is aware; is received soon after submission; provides specific advice on things that need to be changed; is not too long; clearly indicates to the student the priorities for action and the order of the importance of advice [10].

Feedback is one of the components of learning oriented to assessment model defined by D. Carless, G. Joughin, M.M. Mok. According to the authors, learning-oriented assessment is concerned with three things: designing assessment tasks that engage students in processes that lead to assessment tasks as learning tasks; involving students in the process of evaluating their own work; and building complete feedback loops into learning so that students act on information received – the key concept here is "feed-forward", as students use information provided to progress on their work and their learning [4].

3 Test based sequencing possibilities

According to D. Nicol, D. Macfarlane-Dick, the tests are the most suitable activities in e-learning courses for generating quick and operative feedback to a student [10]. SCORM 2004 Sequencing and Navigation capabilities enable the new test possibilities to provide qualitative feedback to students. In SCORM courses test can be used for course content sequencing and the learners with different abilities can be provided with different learning paths. It is possible to create feedback loops in SCORM compliant e-learning courses so that student could act on information received.

Using the tests and defining the sequencing rules, it is possible to create different adaptive learning paths models corresponding to a student's knowledge and abilities. To create adaptive learning paths models two kinds of tests are used: Pre-Test, Post-Test. The adaptive learning path model shown in Fig. 1 illustrates the use of Pre-Test to control the learning process. In this model Pre-Test assesses the knowledge and abilities of a student and select the learning content necessary to gain the lacking knowledge and abilities. In this model Pre-Test activity has two learning objectives: OBJ-1 and OBJ-2. The questions of the Pre-Test are associated to the corresponding learning objectives. There are two sequencing rules created for the learning objects SCO-1 and SCO-2. These rules define that when a student achieves learning objectives OBJ-1 or OBJ-2 the corresponding learning resources should be omitted. The established rules "Choice=False" "Flow=True" enable the successive learning process.
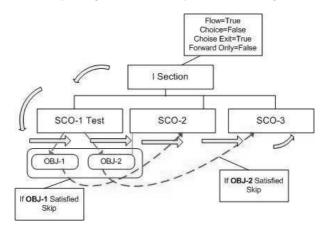
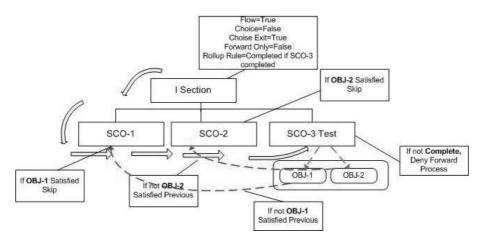**Fig. 1.** Adaptive learning path model based on Pre-Test results.

Fig. 2. Adaptive learning path model based on Post-Test results.

Fig. 2 shows the adaptive learning path model with Post-Test controlled learning process. After the performance of Post-Test a student not only operatively gets feedback about the gained knowledge and abilities, but is also directed how to gain the lacking knowledge and abilities. In this model test activity has two learning objectives: OBJ-1 and OBJ-2. The questions of the test are associated to the corresponding learning objectives. There are two sequencing rules created for the test: the first rule is connected with the learning objective OBJ-1, and the second is connected with the learning objective OBJ-2. If a student does not reach the learning objective OBJ-1 the sequencing rule returns him or her to the learning resource SCO-1 to repeat its content. If a student does not reach the learning objective OBJ-2 the sequencing rule returns him or her to the learning resource SCO-2 to repeat its content.

The rules are also established for the learning objects SCO-1 and SCO-2. These rules define that when a student achieves the learning objectives OBJ-1 and OBJ-2 the corresponding learning resources should be omitted. The established rules "Choice= False" "Flow=True" enable the successive learning process. Test is the only compul-

sory activity of the section. The section is completed if the test is completed. The test is passed if the defined learning objectives OBJ-1 and OBJ-2 are achieved. The rule established for the test "If NOT complete, Deny Forward Process" controls the learning process and forbids to continue the studies until the section test is not passed.

Combining the activities of Pre-Test and Post-Test and defining different sequencing rules is possible to create different adaptive learning paths models in SCORM compliant e-learning courses.

4 Learning management systems used in Lithuania and SCORM support

SCORM based courses can be delivered and tracked by different SCORM compliant learning management systems. Moodle and ATutor are popular open source learning management systems used in different Lithuanian education institutions. Vilnius Gediminas Technical University uses widely accepted, commercial learning management system IBM Workplace Collaboration Learning System.

On purpose to evaluate the compatibility of learning management systems Moodle, ATutor, Workplace Collaboration Learning System (WCL) with SCORM 2004 standard specifications the research has been completed. During the research the functions of the systems under consideration were analyzed. Learning management systems Moodle, ATutor, Workplace Collaboration Learning System (WCL) were tested loading SCORM 2004 standard compliant e-learning course prepared with a help of IBM Authoring Tool. The assessment of the compatibility of the systems under consideration with SCORM 2004 specifications is shown in Table 1. The table data show that only the learning management system Workplace Collaboration Learning System supports SCORM Sequencing and Navigation specification.

The integration of SCORM 2004 has not been fully accomplished yet. All of analyzed systems support SCORM 1.2 specification, but the latter does not contain the Sequencing and Navigation specification. Only Workplace Collaboration Learning System 2.6 implements a sequencing engine based on the SCORM Sequencing and Navigation specification. All of analyzed systems support the importing of SCORM Packages as described in the SCORM Content Aggregation specification. Moodle and Workplace Collaboration Learning System provide implementations for the SCORM 2004 Run-Time API for the communication of the Learning Objects with the LMS.

Table 1. Learning management systems and SCORM integration.

No.	Learning management system	SCORM
1	ATutor 1.6.4	SCORM 1.2 SCORM 2004 Content Packaging
2	Moodle 1.9.3	Fully Support of SCORM 1.2 SCORM 2004 Content Packaging SCORM 2004 Run-Time (partially)
3	Workplace Collaboration Learning System 2.6	Fully Support of SCORM 1.2 SCORM 2004 Content Packaging SCORM 2004 Run-Time SCORM 2004 Sequencing and Navigation

5 Conclusions

1. The importance of assessment feedback in e-learning is emphasized by many authors. SCORM 2004 Sequencing and Navigation capabilities enable the adaptation of e-learning courses content in accordance with the knowledge and abilities of students; enable the realization of feedback loops in e-learning courses that student could act on information received.

2. Combining the activities of Pre-Test and Post-Test and defining different sequencing rules is possible to create different adaptive learning paths models in SCORM compliant e-learning courses.

3. The research of the compatibility of learning management systems Moodle, ATutor, Workplace Collaboration Learning System used in Lithuania with SCORM standard specifications showed that only the learning management system Workplace Collaboration Learning System supports SCORM Sequencing and Navigation specification.

References

[1] ADL (November 16, 2009). *SCORM 2004 4th Edition Overview – Sharable Content Object Reference Model.* Available from Internet: http://www.adlnet.gov.

[2] *ATutor: Learning Management System.* Available from Internet: http://www.atutor.ca/.

[3] A. Bischoff. The elements of effective online teaching: overcoming the barriers to success. In K.W. White and B.H. Weight(Eds.), *The Online Teaching Guide: A Handbook of Attitudes, Strategies, and Techniques for the Virtual Classroom*, pp. 57–72, Boston, 2000. Allyn & Bacon.

[4] D. Carless, G. Joughin and M.M.C. Mok. Learning-oriented assessment: principles and practice. *Assessment & Evaluation in Higher Education*, **21**(4):395–398, 2006.

[5] L.L. Chew. *Instructionalstrategies and limitations of the SCORM 2004 specification.* Available from Internet: http://apsce.net/icce2008/papers/ICCE2008-paper282.pdf.

[6] G. Hillesheim. Distance learning: barriers and strategies for students and faculty. *Internet and Higher Education*, **1**(1):31–44, 1998.

[7] C.-C. Lin and J.-H. Pan. A case study on the scorm-based e-learning in computer-aided drafting course with users' satisfaction survey. *Wseas Transactions on Information Science & Applications*, **5**(10):1426–1437, 1998.

[8] M. Melia, R. Barrett and C. Pahl. A model-based approach to SCORM sequencing developing. In *7th Annual Irish Educational Technology Users Conference EdTech*, 2006. Available from Internet: http://www.computing.dcu.ie/m̃melia/docs/conferences/EdTech06/paper/edtech06.pdf

[9] *Moodle: learning management system.* Available from Internet: http://moodle.org.

[10] D. Nicol and D. Macfarlane-Dick. Formative assessment and self-regulated learning: a model and seven principles of good feedback practice. *Studies in Higher Education*, **31**(2):199–218, 2006.

[11] G. Rodríguez Gómez, M.S. Ibarra Sáiz, J.M. Dodero, M.A. Gómez Ruiz, B. Gallego Noche, D. Cabeza Sánchez, V. Quesada Serra and Álvaro Martínez del Val. Developing the e-learning-oriented e-assessment. In A. Méndez-Vilas and et al.(Eds.), *Research, Reflections and Innovations in Integrating ICT in Education*, pp. 515–519, 2008. Available from Internet: http://www.formatex.org/micte2009/book/515-519.pdf.

[12] D.R. Sadler. Formative assessment and the design of instructional systems. *Instructional Science*, **18**:119–144, 1989.

[13] J.K. Seale, J. Chapman and C. Davey. The influence of assessments on students' motivation to learn in a therapy degree course. *Medical Education*, **34**(8):614–621, 2000.

[14] H. Srimathi and S.K. Srivatsa. Design of virtual learning environment using SCORM standards. *Journal of Theoretical and Applied Information Technology*, pp. 542–546, 2008.

[15] E. Vasilyeva, M. Pechenizkiy and P. Bra. Adaptation of feedback in e-learning system at individual and group level. In *PING2007 Workshop on Personalisation in E-Learning Environments at Individual and Group Level, at the User Modeling Conference, Corfu, Greece*, pp. 49–56, 2007.

[16] *Workplace Collaborative Learning System: Learning Management System*. Available from Internet: http://www.redbooks.ibm.com/redbooks/pdfs/sg247254.pdf.

REZIUMĖ

Testų taikymas mokymosi eigai valdyti SCORM standartą atitinkančiuose e-mokymosi kursuose
J. Lieponienė, R. Kulvietienė

Straipsnyje nagrinėjama vertinimo grįžtamosios informacijos svarba e-mokymesi, analizuojamas testų taikymas mokymosi eigai valdyti, vertinamas mokymo valdymo sistemų Moodle, ATutor, Workplace Collaboration Learning System suderinamumas su SCORM specifikacijomis.

Raktiniai žodžiai: grįžtamoji informacija, SCORM, testas.