Assessment models in e-learning environments [*]

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Abstract: During the development of any e-learning course assessment is considered a very important part as it measures the obtained knowledge, skills and competences. The assessment activities such as testing, problem solving, collaborative or individual projects development, participation in discussions etc *These activities are to be modeled properly taking into account basic didactical properties of an assessment unit. The assessment unit aggregates one or several assessment activities. Building conceptual and physical models of assessment represents the focus of this paper. The relationships between the proposed conceptual models and proper technological tools concerning the assessment activities are discussed. Some possibilities to apply the assessment results into learner's portfolio are presented.*

Key words: e-learning, assessment of knowledge, skills and competences,

INTRODUCTION

The assessment takes an important place during the development of any of e-learning course. It includes a variety of activities such as testing, problem solving, collaborative or individual projects development, participation in discussions etc. The object of assessment in the educational process is not only the knowledge. The assessment area is enlarged toward the skills and competences. According to [2] the competence is a mastering of knowledge and skills at level that is sufficient for their application for doing of concrete work. This approach to use different assessment methods should be applied in e-learning environments. The assessment methods are grounded on relevant assessment activities e.g. test, individual or collaborative assignment, and discussion. These activities could be aggregated in an assessment unit and they could be used to measure student's achievements and driving of learning path in concrete e-learning course, module, chapter, lesson etc..

The conceptual and physical models of an assessment unit are in the focus of this paper. The paper is organized as follows: Section 1 deals with basic didactical properties of assessment unit and assessment activities- learning objectives, criteria for success and leaning styles. Conceptual models of assessment unit and assessment activities are proposed in Section 2. Physical models of an assessment unit and activities are presented in Section 3. The relationships between conceptual models and technological tools for assessment activities are also considered. The possibilities for connections of the results of assessment unit into learner's portfolio are discussed.

BASIC DIDACTICAL PROPERTIES OF ASSESMENT ACTIVITIES
Learning objectives

The learning objective describes the level of knowledge, skills, competences and other characteristics that any learner should achieve in the process of learning. Learning objectives drive the whole educational process. They explore what content should be included in the learning materials and at what level of the cognition of the learning material should be mastered. The learning objectives have to be measurable. For the description of learning objectives two basic domains, namely knowledge domain and cognitive domain could be used. The knowledge domain describes the concepts, facts, procedure, and appearance from concrete learned material. Usually the cognitive domain is described according to some well known taxonomy. One popular and useful taxonomy is the Bloom's

cognitive taxonomy, based on six cognitive levels- Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. The detailed approach for active using of learning objectives in e-learning courses and environments we presented in [3]. For each assessment unit could be assigned the matrix of learning objectives, which this unit measures (Table 1)

Table 1. Example of learning objective matrix

Assessment object	Cognitive Level 1	Cognitive Level 2	Cognitive Level 3	Cognitive Level 4	Cognitive Level 5	Cognitive Level 6
Concept 1						
Concept 2						
Fact 1						
…….						

Criteria for success

The criteria for success or so called "cut off level" could be described on the base of expert evaluation. The experts define the minimal level of mastering for each learning objective in percentages. The criteria for success could be described in a matrix of cut off levels according to the expert evaluation and relevant statistical method for expert evaluation.

Table 2. Example of a matrix of cut of levels.

Assessment object	Cognitive Level 1	Cognitive Level 2	Cognitive Level 3	Cognitive Level 4	Cognitive Level 5	Cognitive Level 6
Concept 1	89%	80%				
Concept 2	78%	75%	70%	65%	65%	
Fact 1	88%	76%	71%			
…….	91%					

Learning styles

The learning style reflects the way of accepting and processing information. There exist more than 70 theories for learning styles [1]. Being aware of student's learning styles is important for the design process of e-learning environments and for the processes of design, development and implementation of concrete e-learning course. For example the people with interpersonal style of learning need collaborative learning and assessment activities. The people with intrapersonal learning style prefer personalized and individual learning and assessment activities.

CONCEPTUAL MODEL OF ASSESSMENT UNIT IN E-LEARNING ENVIRONMENT

The conceptual model of assessment unit is based on the assessment methods (Figure 1) that include the relevant assessment activities.

Input data for the conceptual model are learning objectives, criteria for success (Cut off level) and learning styles. These tree properties are prerequisites for the choice and implementation of the assessment activities.

In addition we define the following properties in the conceptual model of the assessment unit:

- Structure, order and type of assessment activities.
- The intend of the activities and reflection of their results in the learner's portfolio:

- o self-assessment;
- o pre- assessment;
- o formative assessment;
- o evaluation and grading.
- The weight of the each assessment activity in the final grade.
- The grade scale.
- The time and duration of the each assessment activity, included in the assessment unit.

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┌─────────────────────┐
│ Assessment methods  │
└─────────────────────┘
        │
        │   ┌─────────────────────────────┐
        ├───│ Individual                  │
        │   └─────────────────────────────┘
        │        │   ┌──────────────────────────────────────────┐
        │        ├───│ Test                                     │
        │        │   └──────────────────────────────────────────┘
        │        │   ┌──────────────────────────────────────────┐
        │        └───│ Assignment/ problem solving/ project     │
        │            └──────────────────────────────────────────┘
        │   ┌─────────────────────────────┐
        └───│ Collaborative               │
            └─────────────────────────────┘
                 │   ┌──────────────────────────────────────────┐
                 ├───│ Assignment/ problem solving/ project     │
                 │   └──────────────────────────────────────────┘
                 │   ┌──────────────────────────────────────────┐
                 └───│ Discussion                               │
                     └──────────────────────────────────────────┘
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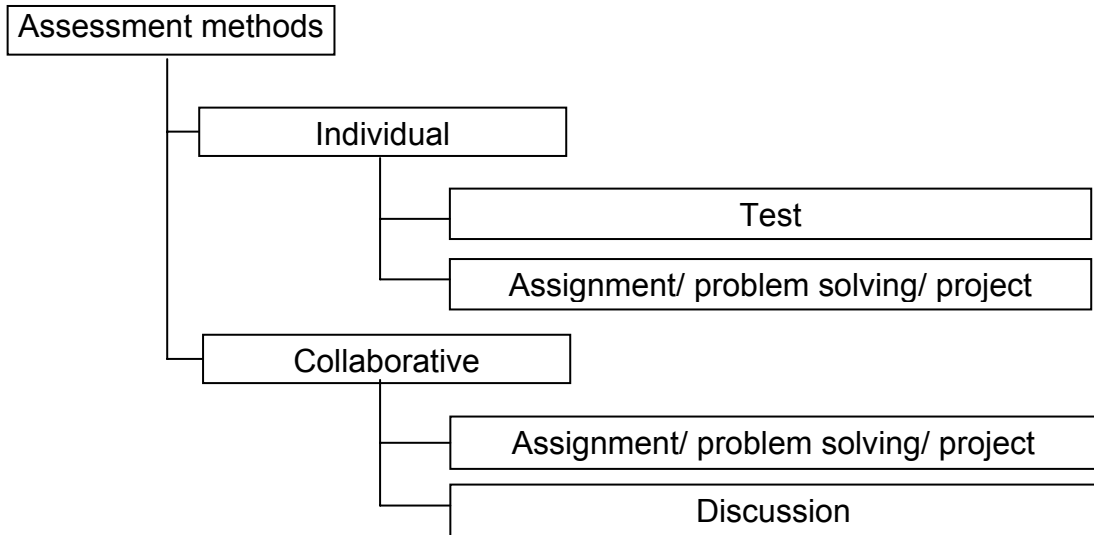
Figure 1 Assessment activities.

Each of the activities, presented at Figure 1, has an own conceptual model. These models share common properties- learning objectives, cut off level, and learning styles for which they are suitable.

Specific properties for assessment activity "Test" are as follows:

- Type of the test- Criterion Referenced or Normative Referenced.
- Validity of the test.
- Adaptivity.
- Number, type and weight of the test items for each controlled learning objective.

For the assessment activity "Individual assignment" additional properties are:

- Number of task (sub task) needed for implementation and decision of the assignment.
- Weight (scores) for each task (sub task).
- Common number of scores for whole assignment.

Specific properties for the assessment activity "Collaborative assignment" are:

- Number of task (sub task) needed for implementation and decision of the assignment.
- Weight (scores) for each task (sub task).
- Common number of scores for whole assignment.
- Schedule of the responsibility of each team member for implementation of the assignment.
- Criteria for evaluation of individual achievements of each member of the team
- Criteria for evaluation of the achievements of the whole team.
- Possibilities for pear to pear assessment.

For the assessment activity "Discussion" the additional properties are:

- Topic of discussion.
- Role of the teacher:
  - o Passive- the teacher observes and evaluates the student's participation in discussion;
  - o Active- the teacher turns of student's attention with the assisted or instigated questions.
- Type of discussion- "brain storming", analysis of situation etc.
- Object for assessment- abilities for setting of questions, investigation of optimal decisions, speed of answers etc.

PHYSICAL MODEL OF ASSESSMENT UNIT

A physical model of Assessment Unit (AU) is a deployment project of this unit within concrete Learning Content management System (LCMS), e.g. with technological limits of this system. Figure 2 presents relationships between elements of conceptual model and possible assessment tools for deployment of assessment activities.

A physical model of the AU specifies deployment of the following assessment activities – test, assignment (individual or collaborative) and discussion.

Deployment project for activity "Test" defines:
- Test generation (choice of test items):
  - o Manual;
  - o Automatic – with or without respect with didactical characteristics.
- Presentation of test items: radio buttons, drop-down menus, list menus, image maps etc.
- Technology used for delivering of testing materials: on-line, off-line, hard copy or export in different electronics formats.
- Multimedia elements in test items: graphical objects, video or audio clips etc.
- Storage organization of test items, tests and test results.
- Reusing of test items and tests already stored in LCMS storage or development of new ones.
- Tools used for analyzing of test results: test items analysis, test analysis, achievement analysis.
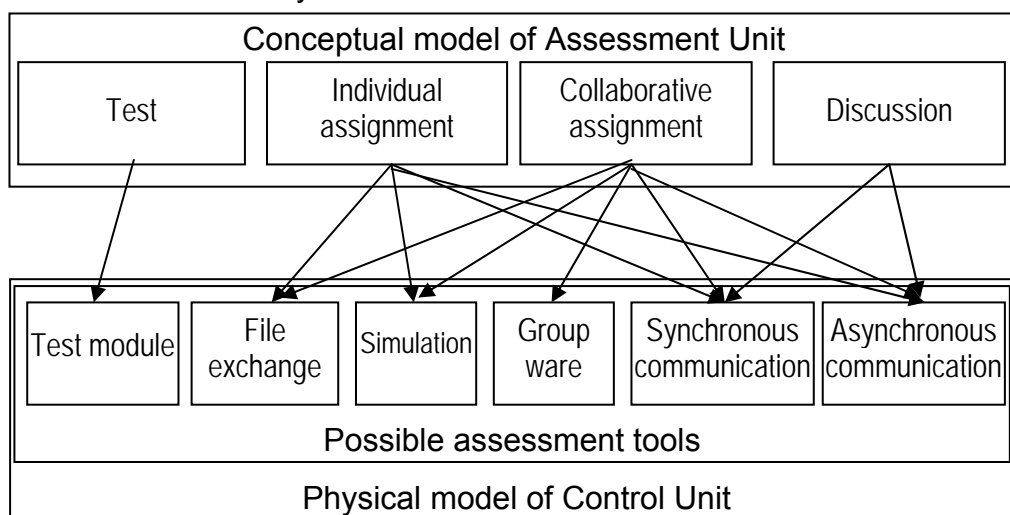

Figure 2. Relationships between elements of conceptual model and used LCMS assessment tools for deployment of assessment activities.

Deployment project for activity "Individual assignment" defines:
- File exchange tools: ftp/http based, e-mail file attachment, ICQ file exchange.

- Simulation tools: integrated or not in LCMS.
- Asynchronous communication tools: e-mail, mail list, discussion forum.
- Synchronous communication tools: Chat, ICQ, audio or video conference;

Deployment project for activity "Collaborative assignment" defines:
- Groupware environment: integrated or not in LCMS.
- File exchange tools: ftp/http based, e-mail file attachment, ICQ file exchange.
- Simulation tools: integrated or not in LCMS.
- Asynchronous communication tools: e-mail, mail list, discussion forum.
- Synchronous communication tools: Chat, ICQ, audio or video conference.

Deployment project for activity "Discussion" defines:
- Asynchronous communication tools: e-mail, mail list, discussion forum.
- Synchronous communication tools: Chat, ICQ, audio or video conference.

CONCLUSIONS AND FUTURE WORK

The assessment unit could be used not only for evaluation and grading. It could be applied to drive the learner through the learning path into the course, module, chapter, lesson etc. The results of the assessment activities such as description of achieved and measured knowledge, skills and competence, developed projects etc are suitable to be included in the learner's portfolio and in this way the current learner's status could be defined. This status could be carried out also for moving of the student from one course to another, from one LCMS to another.

Our future work will be directed to the compatibility of the proposed models of assessment activities with the e-learning specifications of IMS Global Learning Consortium [4].

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