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## Application of Learning and Testing Intelligent System with Cognitive Component Based on Mixed Diagnostics Tests

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### Abstract

Relevance of computer based learning and testing of students is discussed. Learning and testing intelligent system (LTIS) is proposed for learning, testing, learning results and dynamics assessment. LTIS is aimed at professional and personal skills and abilities estimation, and also for designing learning trajectory of courses. A new assessment approach called mixed diagnostic tests (MDT) for LTIS construction is discussed. Analysis of the effective MDT and their implementation are proposed. The cognitive component based on 3-simplex and 2-simplex prism is suggested. MDT reduces both time and cost expenses for organization and control of the educational process. Since MDT may replace consultant function of teacher, the proposed approach is promising in the blended learning. The decision-making results are justified via cognitive component.

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*Keywords:* Learning and testing intelligent system; mix diagnostics test; cognitive component; blended learning; 3-simplex; 2-simplex prism.

### 1. Introduction

Nowadays development of learning and testing intelligent systems (LTIS) is relevant problem (Levin, et al., 2004; Brusilovsky, et al., 2006; Uskov & Uskov, 2010; Yankovskaya, 2011a; Yankovskaya & Semenov, 2011;

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Yankovskaya & Yevtushenko, 1997). Emerging information technologies provide a number of innovative and very promising technologies for teaching and learning. A significant group of the technologies are related to the distance, on-line education or to the education involving limited interaction between students and teachers. During the last decade, blended learning technologies have become ubiquitous (Singera & Stoicescu, 2011; Graham, 2006). Such technologies affect both the educational practice and the principle approaches to the distance education by improving collaboration which is a very important component of education. At the same time, the problem of assessment and improving efficiency of the educational process becomes relevant even more than in a conventional class, due to absence of the teacher in such a class. The concept of blended learning, which is a learning combining both education and training, was introduced in (Bliuc, et al., 2007). In general, the blended learning corresponds to an integrated learning environment, which combines e-learning with traditional classroom teaching (Graham, 2006). One of the main problems of high school is to develop mechanisms for effective training a large number of students by a wide diversity of tasks (Singera & Stoicescu, 2011).

The simplest example of the blended learning is using diverse resources and methods within the structured and targeted syllabus. Despite of the variety of information technologies (including methods of artificial intelligence), methods for diagnostics of the gained knowledge in the teacher-student interaction are not developed enough. The development of such methods is highly time-consuming and requires considerable efforts (Brusilovsky, et al, 2006; Uskov & Uskov, 2010). Students of different abilities have diverse preferences in learning and achieving goals of lessons. Ausburn (2004) used a questionnaire aimed to study students' abilities, such as the initial level of their knowledge, skills, and experience. Orientation on student's particular interests and capacities should make the learning process more effective. Any student (bachelor, master and specialist) should rely on experience and skills obtained at a higher school to find the proper solution of educational and industrial tasks. Moreover, the student should understand very clearly, why and how he/she will use the obtained knowledge, professional and personal skills, and abilities to reach his/her goals. Bliuc et al. (2007) identify four different ways to define the blended learning. The blended learning can be considered as: a) combining modes of web-based technology; b) combining of various pedagogical approaches; c) combination of instructional technologies with a face-to-face instructor-led training; or d) combination of teaching with practical work.

In our paper, we propose a new approach for learning and testing based on mixed diagnostics tests (MDT) LTIS with cognitive component. The approach is based on so-called MDT introduced by A. Yankovskaya in 1996 for intelligent systems construction and further developed for LTIS construction. MDT being one of the most adequate and useful tools is a compromise between unconditional and conditional components which expediently to use in blended education and training. The most effective ways of learning and testing results assessment in LTIS based on MDT is cognitive graphic tools (Yankovskaya, et al., 2014a; Yankovskaya, et al., 2014b). The cognitive graphic tools are used in different intelligent systems for information data and knowledge structures analyzing, for revealing regularities of different kinds and decision-making and its justification. They are widely used in LTIS for teaching and learning activities optimization, for visualization and learning process results forecasting, etc. But the development of these tools for each problem area is very time-consuming and expensive. In the cognitive tools which are invariant to different problem areas were developed (Yankovskaya, 1997). Application of these tools is relevant both for the objects' parameters analysis and for decisions justification as well as for dynamic processes analysis. Visualization simplifies the information analysis and allows decision-making in effective way.

Present paper continues the research on creation of based on MDT LTIS with cognitive component invariant to the problem area. Mathematic basis of an object under study representation in  $n$ -simplex is briefly described and basis of representation of a process under study in 2-simplex prism is given. Examples of 2-simplex prism application in developed and developing LTIS are presented. Further research directions are proposed.

## 2. Problem background

The modern society involves dynamic, frequently unpredictable changes, which call for students and graduates to be able to solve different educational and professional tasks (Singera & Stoicescu, 2011). It should be noted that blended education and training calls for an extension of range of skills, experience and knowledge (competences) of both teachers and students. Students of different abilities have diverse preferences in process of learning and reaching their goals. In her study, Ausburn (2004) used a questionnaire aimed to assess university students' abilities

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