

Intelligent Collaborative Educational System within the Framework of Competence Approach

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Abstract. In modern society, lifelong learning is a learning process based on persons' need to acquire knowledge, skills and experience to enhance or change their qualifications in accordance with the demands of the labor market, their own interests and needs. This Article is dedicated to one of types of lifelong education - collaborative education, which is described from the point of view of competence approach. The Article deals with the characteristics, basic tasks and the operational process of collaborative educational system. The conceptual model and basic functions of intelligent collaborative educational system are presented; the functions of system basic models and the scheme for development a training scenario are described.

1 Introduction

In today's society, no one can call into question the effect of new technologies on the educational system. In this new reality, at any level of education, the study process should be organized in such a way that graduates become the so-called knowledge workers in the full sense of this term [11]. This means that the training becomes more learner-centred, providing training opportunities for individual and professional development purposes, and educational institutions seek for flexible and dynamic response to changes on the labor market and in daily life.

One of the characteristics of the 21st century is the transition to the knowledge economics and the transition of information to the source of economic growth and profit. The staff and their knowledge as well as their growing professional competence have become the basic resources of organization development. In order to be competitive, it is necessary for knowledge workers to continuously acquire innovative knowledge. This makes the process of staff continuous training as one of the priorities in the functions of staff management in modern organizations. Thus lifelong education is becoming increasingly important.

According to [6], lifelong education is the process of personal, social and professional development of the individual throughout their lifetime to improve the quality of life. It is a comprehensive and uniting idea which includes formal, beyond-formal and non-formal education.

Lifelong education is a continuous process in which a person is involved from youth to old age, it requires flexibility of mind, the desire to complement and broaden the knowledge as well as the desire for continuous development as a full and versatile

person, and it enables an individual to adapt to the changes on the modern labour market. The rationale for adults to engage in lifelong education can be varied, both internal and external. Internal motives refer to the wishes of the person to acquire new competences; the external motives are the various demands of person's workplace.

On the other hand, information and communication technology opportunities and capacity are constantly increasing, leading to a continuous increase in the volume and variety of service activity in any area, including education. Therefore, the concept of collaborative educational system has appeared in the modern society. On the modern labor market, there is an increasing demand for creative, responsible, dynamic and well-prepared employees who can quickly adapt to changes, who know how to cooperate with other employees, who are open to different cultures, with flexible thinking, etc. [Dam14]. In this context, collaborative education is becoming increasingly important.

The paper is organized as follows. Section II describes the basic principles of competence approach in education. Section III outlines characteristics and key objectives of collaborative educational system. Section IV presents a conceptual model for the intelligent collaborative educational system, while Section V discusses questions related to user group formation of this system. Section VI concludes the paper by briefly discussing the future direction of research.

2 Systems of Collaborative Education

A distinctive feature of collaborative educational systems is the development of domain knowledge, the use of individualized education and training strategies based on the model of the user. The benefit of collaborative educational systems is an advantage of independence from a student placement, but the difference between the classes of users is an important problem, as the system should be used for a very diverse set of students.

Systems of collaborative education possess the following characteristics:

- the aim of the system is to provide students with adequate support in the process of problem solving as an instructor-human would have done;
- any system of collaborative education is based on a user (student) model, taking into account the set of characteristics of the adults as well as the current level of professional competence and knowledge;
- at the basis of studies, there is the underlying study program based on the student characteristics and needs, the purpose of education and the required range of competencies;
- education is geared to the needs of employers;
- during studies, there are developed skills for the user to apply knowledge for specific practical tasks;
- self-motivation is of great importance in such systems;
- education takes place in collaboration, promoting equal partnership.

In general, the key objectives of collaborative educational system are considered to be:

- the development of a model of competence based on existing standards and labor market requirements;
- student registration and development of his or her personal space;
- the development of the current model of each participant based on a deep and thorough diagnosis and a comparison with the competence model with a view to determining the goal of the education process of each participant;
- development of a training strategy (program) at the basis of the goal of student education process;
- formation of collaborative education groups, taking place separately for each study course module based on the current status and personal characteristics of students;
- developing the content (scenario) based on the existing training strategy and the groups formed;
- formation of teaching staff and auxiliary staff team, based on employee characteristics and study programs;
- determination of labor-intensity and labor input of the training scenario;
- implementation of training, support for maintaining the training process, formation of teaching-methodology group;
- implementation of control, updating of the student model, determination and evaluation of study results.

As part of this process, an inspection is carried out as to whether each unit established corresponds to the model of the student (specialty, training objectives and the level of knowledge, skills and competences) and the model of competence. If there is conformity, the unit is considered to be created, otherwise the process will recur.

3 Conceptual Model for the Intelligent Collaborative Educational System

The term “intelligent system” is used in the field of artificial intelligence and identifies a system using artificial intelligence with a view to providing better support for system users. There is no uniform definition of intelligent system at present, for example [1] gives the following explanation: “The technical or software system, the operational resolution of which is traditionally regarded as creative and belonging to a particular item of understanding, the knowledge of which is kept in the system memory; an intelligent system consists of three main blocks: the knowledge base, solver (output mechanism) and an intelligent interface”.

Mostly intelligent systems are knowledge based systems and focus on processing knowledge (not on processing data or information). Therefore, the intelligent system is a system based on knowledge, i.e. a domain model, described in the language of knowledge interpretation (ultra-high level programming language, close to natural language) [17].

Intelligent systems are widely used in different fields to meet versatile challenges. One of such tasks is planning – organization of a system with a view to achieving a defined objective taking into account certain restrictions. Intelligent educational systems also belong to these systems.

The education content model includes the strategies (regulations on the behavior of the system) of study program and study content (scenario) development and management. The student model contains information about the student, the set of characteristics (personal data, level of knowledge, etc.). Competence model: a set of required competences based on industrial requirements comparing current and acquired competences of students. Domain model includes study objects (study courses, tasks, tests, control questions, etc.).

The models are in accordance with the base modules, the rest of modules provide ancillary functions. This could be: module design and analysis module, module for the implementation of training, module for knowledge base validation (correctness check) module, etc.

We will review the functions of the base modules.

User interface:

- registration of users and development of personal space;
- access to the knowledge base;
- interaction with other modules;
- input of current values for the assessment of student competences, values for student characteristics, etc.

Module for program development:

- comparison of the value of student's competence rating values with the value required for the assessment of competence (i.e., competence model);
- determination of the study program (training strategy), taking into consideration the student's characteristics as well as the difference between the value of student competence assessments and the values required according to the assessment of competence, i.e. the definition of a set of study modules for each student.

Group formation module:

- based on the established program for each student, his/her personal characteristics and current situation, collaborative groups are created for module studies of each study course;
- checking the adjustments of groups created for each study course module. If a group is not formed, the students outside groups are united in groups, not taking into account the characteristics and present situation.

Training scenario development module:

- sequence planning for study course modules;
- implementation of training, support for the maintenance of the study process.

Control module:

- implementation of the control of acquired knowledge;
- upgrading of the student module;
- generation of management solutions appropriate for study process to achieve study objectives;
- determination and evaluation of study results.

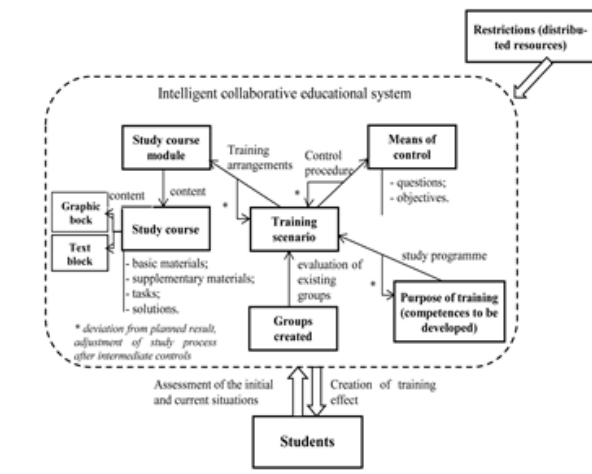


Fig. 1. Diagram for development a training scenario

All the activities of the system are carried out, taking into account the limitations of the resources distributed, and directly linked to the student. Development of model training scenario could therefore be presented as shown in figure 1.

The following concepts are highlighted in figure 1:

- the text and graphical block is the minimum unit of presenting information in the text and in the graphic form respectively (e.g. paragraph, sentence of the text block, etc.);
- the study course allows the combination of different information in the form of text and graphical block in various structures;
- a study module is a set of study courses (it may also be traineeship) which has a logical completeness and that is intended to a certain competence, i.e. study of inter-related courses.

4 Questions Related to User Group Formation of Intelligent Collaborative educational system

Collaborative education provides benefits for cognitive achievements, but their effectiveness depends on such factors as the previous knowledge of group participants, team composition and quality of explanations [12]. Without adequate prior knowledge, students fail to provide high-quality explanations or properly understand the perspectives provided by other members of the group [22].

One of the problems related to collaborative educational system: how to divide students into study groups and according to which criteria. One approach: dividing into groups based on the level of knowledge and current competencies of each member, taking into account also his/her cognitive and social capacity.

There are also a number of approaches in determining the optimum number of participants in the group. It is most often recommended to divide the participants into as small groups as possible, 2-5 people in a group [2, 15].

In the research [13], the author offers a review of literature sources related to research of collaborative education. It has been noted that, within the framework of collaboration, both interaction models and the success of collaboration vary across groups with different levels of participants' capacity. In the research, studies were considered in which groups with both a high spectrum and a narrow spectrum participated (where there were students with high – mean capabilities and mean – low capabilities). In the groups with a wide spectrum of abilities, high and low capacity participants represented the teacher–pupil relationship, while the medium level capacity participants stayed away. In the groups with narrow capabilities, medium capacity participants worked much better. In these groups, all the students had a tendency to participate actively in the work, and medium and low capacity participants showed a higher achievement. The research has shown that collaboration has a strong impact on student learning outcomes, especially as it relates to participants with low skills, and the groups with a narrow difference in capacity levels are the most successful ones.

Development of an efficient collaborative educational system includes sub-tasks: how to choose and quantify appropriate characteristics to develop a system user model to divide users into optimal groups for study purposes [14].

The research [18] provides a methodology for determining the level of competence of knowledge workers: the level of competence of staff members is calculated by means of an audit procedure based on different methods and techniques of competence analysis. From an audit point of view, each competence includes the title and attributes set to define it. Each attribute of a particular worker is assessed in some way (for example, through a survey or an interview). The collected attributes make it possible to calculate the staff member's level of competence.

Each employee i possesses a set of competences characterized by competence vector $com_i [com_{1,i}, com_{2,i}, \dots, com_{n,i}]$ where n is the number of competences and the value $com_{n,i} > 0$ is the initial assessment of competences carried out with an audit procedure. In addition, value $com_{n,i}$ can be changed after the loss or transfer of knowledge, training or other knowledge related processes.

Another question which has to be addressed arises: is competence a binary property or not? In the field of education, competence may be assessed by scale, with degree or "size". In the research [9], it is noted that competence may consist of several sub-domains and may include the use of a number of related elements, so that a lower level competence can be considered binary, whereas a higher level competence - able to be partially completed. For example, the level of competence may be normalized and linked to the audit procedure of a specific employee: beginner (0-0,2), initiator (0,2-0,4), trainee (0,4-0,6), skilled employee (0,6-0,8), expert (0,8-1) and master (1) [8].

5 Conclusion

There is no doubt that major changes in higher education are currently taking place. Educational institutions offer ever more lifelong education opportunities for lifelong education and adult education. The main aim of this activity is to ensure the availability of quality and efficient education for all. In the circumstances where demand for such opportunities is constantly rising, the importance of the intelligent collaborative educational system and development issues associated with it should not be exaggerated, since the development of education should take place directly from the “closed” education model to an open one based on the use of a virtual education environment as the main means of communication between students and educators.

The article deals with the concept and core functions of the concept of the intelligent collaborative educational system, as well as the conceptual model of the intelligent collaborative educational system has been promoted, which might be helpful to the developers of this type of intelligent systems.

Future work will focus on the research of the problem of choosing the knowledge representation models for its use in development of knowledge base for collaborative intelligent educational systems.

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