Intelligent Mobile Models and Their Application in the Educational Process

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Abstract—Using ICTs in education allows the effective integration of new technologies into the educational process. Developing information and communication technologies also require timely changes in knowledge evaluation and use. As a result, methods, techniques, and technologies used in learning are being updated. In this study, a method for developing an automated educational and methodical complex based on a semantic network is described. Requirements for such educational and methodological complex have been formulated. Structural and formal models of tools based on a semantic network have been presented. The purpose of developing the model is to make it easier for students to perceive the various educational and methodological complexes through its compilation on the basis of a holistic view of the subject area, as well as to optimize the work of the teacher.

Keywords—automation, educational process, intelligent model, semantic network.

1 Introduction

The full informatization of our society depends on the industrial method of developing automated systems for managing the educational process with the use of innovative technologies [1,2]. It is proposed to consider the formation of an innovative educational system that would provide high-quality training for a new generation of qualified specialists capable of implementing innovations in the creation and implementation of innovative projects based on one of the national innovations of Kazakhstan. Kazakhstan seeks to integrate the experience of many developed countries through education and the formation of human capital in this process. A study of foreign experience in the field of innovative development of universities has shown that it is thanks to a successful innovation policy that the USA, UK, Germany, and France retain their leading positions, while Japan and South Korea have made a technological breakthroughs and firmly embarked on an innovative path of development.

The use of information and communication technologies in education is formulated with the reasonable introduction of new technologies that adapt the educational process to effective learning [3-5]. The development of information and communication technologies also requires a timely change in the system of evaluation and use of knowledge. In this regard, the methods, techniques, and technologies used in learning are being updated [6].

The essential quality of a modern education system is the use of active, practice-oriented teaching methods [7-9]. The use of which cannot be imagined without digital technology. The problem of widespread use of computer technologies in education over the last decade has increased the interest in national pedagogical science. Modern information and communication technologies have a microprocessor, hardware, and software tools based on computer technologies, as well as modern means and systems of information distribution, possibilities of information exchange, collection, production, accumulation, storage, processing, transmitting of information and access to information resources of computer networks (including global ones). The introduction of computer technologies and the transition to the next stages of informatization are linked to the choice of content for individual disciplines to create computer programs. State educational standards take into account the use of practical methods and technologies as a mandatory component of training [10].

We can observe how people are currently losing value via the Internet because any information can be delivered to the user in a few seconds [11,12]. However, the Internet only gives a person access to documents, reserving the receipt and interpretation of data. The logical development of the Internet consists of the transition from downloading documents published in the Semantic Web concept to the acquisition of knowledge and their automatic processing [13].

At present, the areas of automatic construction of semantic resources, including semantic networks, are of great scientific interest. Classical methods of automatic construction of semantic resources are based on theoretical and graphical methods and are presented in the works of John Sowa, Eduard Howe, Roberto Navigli, Patrick Pantel, Dekang Lin, Chris Biemann, Iryna Gurevych, Christiane Fellbaum, Hinrich Schütze [14]. Modern methods are based on distribution models and vector representations of words described in the works of Tomas Mikolov, Ido Dagan, Richard Socher, and other Russian researchers [15].

The area of scientific research related to the automatic construction of semantic networks is currently being actively developed. A semantic network is an indispensable tool in the field of knowledge demonstration. The main relevance in the use of the semantic network is the effectiveness of data search, and the ability to quickly use knowledge for management decisions. Currently, the semantic network has not lost its relevance, as new technologies are based on the representation and practical application of the concept of "semantic network". Currently, many scientific articles contain many different concepts about the semantic system. The concept of a semantic network consists of 3 main stages:

1. Ways of thinking about education, that is, the concept and the relationship between them;
2. Schematic diagram, i.e. tabs, arrows, pointers, signs;

3. Computer demonstration and database allow to derive and form logical conclusions using algorithms working in these concepts. The semantic network can be displayed as a diagram. Construction of semantic network in the form of diagrams, support of artificial intelligence system. Under the concept of a semantic network, the process of knowledge accumulation in memory is carried out through the associative system of communication between concepts. To Express the semantics in terms of the contract values is very limited. Display tools can access the semantic network model for improvement. In society, this network is widespread. Due to the fact that in the information system, in connection with the design of the database, semantic networks can be comprehensively used to represent the concepts and structure of events. Semantic network - the structure of the model of thinking, storage of information.

A semantic network should be achieved to structure repositories of information and many of the rules released. Many researchers engaged in artificial intelligence, engaged in the study of such systems before the network. Most often, these technologies are now widely covered, that is, there are good thoughts and patterns, but not used in society [16,17]. It has application-specific concepts, but to realize its full potential, it must be linked to a single global system. A semantic network consists of established arcs and directed columns.

The advantages of semantic networks are that it is a fairly clear way to represent knowledge based on the relationship between the vertices and arcs of the network. A semantic network is a mathematical model that reflects knowledge in the proposed field of software. Currently, the semantic network is a very relevant and in-demand network in the field of education. The model of knowledge representation in the form of a semantic network is structurally a graph. As is known, "the graph is a very characteristic mathematical object of adaptation. Therefore, we chose adaptive semantic models as a model of the logical structure of the educational material. The adaptive semantic model of educational material is understood as a multilevel hierarchical structure in the form of a semantic network represented by a directed graph, at the top of which there are concepts of the studied subject area, and the edges indicate the relations between them. The form of a simple semantic model is also presented directly and the learning process, which allows you to take into account the individual characteristics of students [18,19].

Currently, the semantic network is very relevant and in demand in the field of education. The adaptive semantic model of educational material is defined as a multilevel hierarchical structure in the form of a semantic network represented by an oriented graph on top of which there are notions of the studied subject area and the edges indicate the relationship between them. The educational process itself is also presented as a simple semantic model, which allows the individual characteristics of the learners to be taken into account. The system of education and knowledge control is based on a logical and semantic approach, to the principles of building artificial intelligence systems. The system of education and knowledge control combines a procedural and declarative approach to knowledge representation and is based on the theory of semantic networks and effective algorithms [20].

2 Materials and methods of research

The need to use information technologies in education is due to the social necessity of improving the quality of education and the practical necessity of using modern computer programs in educational institutions. The improvement of the educational process is aimed at the transition from passive ways of presenting and teaching educational material, to an active group and individual types of work, as well as the organization of students' independent work.

2.1 Basic Semantic Web resources

Semantic Web languages contain a set of keywords, that allow them to describe components and statements. Such languages are used to describe ontologies, trends, and data (OWL, RDF, BPMN, etc.), as well as to perform unique resource identifiers - Uniform Resource Identifier (URI), Uniform Resource Locator (URL), etc. URL language indicates unique names for all elements of the global network. With its help, an extensible namespace is established. Access to different levels of memory with URLs is carried out with the help of unique resource names URN (Uniform Resource Name).

Ontology is a conceptual model of a subject area that defines the concept, relations, and limitations of objects. Many ontologies can be incorporated into any application, adapting to the specific needs of that domain.

Tools can be of four kinds: design and development of semantic network applications, reference tools for network exploration, resonator devices including rule inference mechanisms, and machines for extending the semantic network.

Software development tools allow you to compile or integrate the semantic network by creating or importing components for the instance ontology. Some graphical tools (GUI) allow you to view and explore network data, creating a useful semantic network editor.

Reference tools provide navigation through the semantic web in search of an answer to a user's question. Starting with various reference methods, simple column navigation when searching, and full use of the query language.

Resonator mechanisms add new concepts to the semantic network as needed by users. Components create logical extensions in the form of classifiers. Classification fills the class structure, allowing appropriate identification of concepts and relationships with other classes. Several resonators offer different levels of thinking. Resonators are inserted into other tools and frameworks. They are the levers for creating logically correct auxiliary conclusions.

Network data reflects the meaning of data and integration, including the use of multiple existing data sources, access and ability to share rich data, and information resources of the global information network for common use.

Dynamic data networks make it possible to achieve dynamic (at execution) changes in the structure and content of information.

Semantic Web frameworks are a set of software tools, and environments, for creating libraries, and manipulating and enriching semantic networks. They help to create templates, ontologies, and network applications and publish them on the global network. Examples of such tools and environments are the Eclipse IDE, the Java programming language, a set of libraries for working with Apache Jena, and tools for creating Protégé ontologies.

RDF language was approved by the W3C consortium as a standard in 2004. It is designed for systematic description of network resources, understandable to a computer. RDF is designed to store metadata, to describe semantic resources, i.e. to create individual components of a global semantic web. RDF documents are automatically processed by the computer. RDF Schema, RDFS is an RDF superstructure, which allows the creation of classes and properties of objects.

OWL (Web Ontology Language) has been in use since 2004, it is built in RDF and RDFS formats and is designed to process the information on the web. The OWL language has 3 degrees. It is easily scalable and conforms to modern network standards. In 2008, a new OWL 2 standard was adopted, containing a description of the logic.

SPARQL (Protocol And RDF Query Language) is a new query language for quick access to RDF data. Using a simple protocol and SPARQL language, programs get RDF resources and necessary information from the network.

It is recommended to use **RIF** (Rule Interchange Format) as a rule exchange format along with other formats.

Ontology is the basis for the standardization of the world system of knowledge, including language, engineering, and systems activities. International profile standards of terms and definitions and several international bodies responsible for their maintenance have appeared (ISO, W3C, and some others). Ontology in the semantic global network represents an apparatus for constructing a conceptual model of some subject area, which includes concepts, relations, and limitations of its elements. Utilizing the mentioned languages of semantic network any subject area of accumulated knowledge is formed. The conceptual model includes data structures including relevant classes of objects, their relations, and provisions (theorems, restrictions) accepted in this domain.

The idea of the Semantic Web was first announced in 2001 by Tim Berners-Lee (creator of the World Wide Web). However, it is not new either for the author or for the web community as a whole. Its essence is automation, that is, the processing of information and its exchange should not be handled by people, but by special intelligent agents (programs on the Web). But to interact with each other, agents must have a common (shared by all) formal representation of the meaning of any resource. It is to represent a common, explicit, and formal meaning specification that Semantic Web uses ontologies.

In the five years since the first publication of the Semantic Web, several standards and recommendations have been developed and many projects have been implemented. But despite individual successes, it is still not possible to say (as T. Berners-Lee himself admits) that the idea of the Semantic Web has been realized in practice. This section describes the prerequisites for the Semantic Web, the path that researchers created between 2001 and 2006, and the obstacles that emerged along the way.

Semantic networks emerge from a long study of memory in the field of cognitive psychology. Semantic memory takes into account a person's ability to construct reality.

Human interpretation allows for decoding past anxieties, assumptions, and causal relationships, forming new combinations of knowledge.

A semantic network is a graphical notation reflecting knowledge in the form of nodes and interconnected ribs. Links - relationships between nodes. The graphical representation of nodes is formed by circles or rectangles, and links - by arrows or marked edges. In addition, a major advantage of this system is that it allows an accurate representation of the information stored in human memory, which makes it understandable even to computers. This means that with the help of automated systems it is possible to analyze data and information coming into the semantic network and obtain new knowledge in an automated way [21].

3 Results

3.1 The principles of semantic technologies for the design of intelligent systems

Solution of the tasks of modern information technologies (in particular, artificial intelligence technology) transforms modern computer systems (including modern intellectual systems) into semantic computer systems by switching to the meaningful representation of information in the memory of computer systems, which are not an alternative branch of computer systems development, but a natural stage of evolution aimed at ensuring their high level and, above all, their compatibility. The architecture of semantic computer systems almost coincides with the architecture of knowledge-based intelligent systems.

The differences here are in semantic computer systems: there is a semantic understanding of the knowledge base; the interpreter of knowledge and skills is the team of agents who process the knowledge base and manage the situations and events in this knowledge base. As a result, semantic computer systems have a high level of learning capability, i.e. they can quickly acquire new knowledge and skills and improve them. At the same time, they have no limitations on the type of knowledge and skills they acquire and improve, as well as on how they can be used together. In addition, the proposed approach to the development of semantic computer systems eliminates the duplication of engineering solutions and makes it possible to speed up the development of semantic computer systems using reusable and mutually compatible components that are constantly expanding.

Semantic computer systems are a new generation of computer systems that eliminate many of the shortcomings of modern computer systems. However, the mass development of such systems requires appropriate technology, which must include the following:

- the theory of semantic computer systems and the entire complex of standards ensuring compatibility of the systems under development;
- methods and tools for designing semantic computer systems;
- methods and means of continuous improvement of the technology itself [21].

3.2 Intellectual model in the educational process

The modern stage of informatization of higher education is characterized, above all, by the comprehensive use of modern information and communication technologies in various lessons, research activities, and independent work of students. It should be noted that modern means of information and communication technologies have pedagogically significant potential, the implementation of which will significantly improve the efficiency of training:

- organization of various forms of activities for students to independently acquire and present knowledge, information stored in databases, hypertexts, hypermedia, and multimedia systems;
- computer visualization of educational information, modeling and simulation of the work of objects, units, and machines under study, and passing through various processes and phenomena;
- automation of computing and information retrieval processes, storage of information on various carriers, in databases and banks, information exchange;
- diagnostics of students' intellectual abilities, their level of knowledge, skills, and preparation for a specific lesson;
- automation of the processes of information and methodical support of an educational institution;
- automation of processes for monitoring the results of training, learning and testing activities, generation of tasks depending on the intellectual level of a particular student, his or her level of knowledge, skills, and specific motivational features;
- creating conditions for students to carry out independent educational activities, for self-education, self-development, and self-improvement;
- work in the network, ensuring information flow management; manipulation of information, deformation of presented information by various parameters;
- selecting the necessary line of development for the considered material (text, video, graphics, animation), managing the operation of various devices, laboratory stands, etc.

The new generation of educational software is characterized by several features. Firstly, the possibility of using these programs in various classes is being considered: lectures, laboratory and practical classes, as well as in the process of independent work of students. Secondly, the programs include text arrays, model parameters, monitoring modules, computing automation, model implementation, scheduling, and text window generation. The educational material in the knowledge base is placed on the screen, i.e. information is presented in the form of hypertext. Thirdly, the interaction between the user and the system is characterized by an interactive dialogue that brings the dialogue between the student and the system closer to that between the student and the teacher.

The educational base is focused on a specific subject area and contains various information: text, tables, drawings, animation, video fragments, and so on. The service module, which is part of the knowledge base, makes it possible to select a teaching strategy and teaching effects; analyze the level of knowledge, skills, and the correct solution to various tasks; collect information on the learner's generated skills and how to use these skills. The subsystem of intellectual management of the educational process consists of means of intellectual analysis of the volume and structure of knowledge necessary for the organization and management of the educational process.

In addition, the subsystem includes an intelligent advisory program that implements an interactive dialogue between the user and the system; a control and diagnostic module that makes it possible to calculate and evaluate the parameters of the subject of training to determine the optimal training strategy and tactics at each stage of the lesson. An additional section includes:

- a subsystem of intellectual management of the educational process that implements an interactive dialogue between the user and the system and provides answers to user requests; a model of the learner being formed, a training sequence scheme that implements the learning strategy and the possibility of selecting learning effects, mechanisms for adapting the system to a specific learning object and a training sequence scheme that regulates and coordinates the user's working mode;
- means of communication that enable communication between participants in the educational process and the system, and networking;
- tools for intellectual analysis of the volume and structure of knowledge required for the organization and management of the educational process;
- module of service technology, which provides the opportunity to supplement, modify and adapt the system to the needs of a particular educational institution, allowing corrections to be made to any module of the main part and making the necessary calculations. Main tasks of the support section:
- automation of management of the educational process, control over the progress of students in the stages of the lesson, analysis of the information received;
- automation of students' knowledge control and problem-solving skills, statistical processing of control results, error diagnostics;
- implementation of interactive interaction between users (students and teachers) and the training manual;
- performing communication functions between the teacher, the student, and the system;
- performing a coordination function.

Due to the fact that the economy does not stand still, intellectual systems become more in demand when the main factor determining the development of society is the knowledge and skills accumulated by mankind and their availability to a wide range of users, especially knowledge-based systems. At the same time, the most laborious and at the same time most responsible stage in the development of an intelligent system is the creation of a knowledge base, which ultimately determines the usefulness and quality of the entire system. In this regard, models and methods of presentation and processing of knowledge, as well as those created on their basis, play a determining role. A wide range of training and processing models, methods, and tools have been accumulated as part of work on artificial intelligence. The network model offers tools such as semantic networks and frameworks. They are the first to be used in terms of objects and the relationship between them as a universal memory for storing any information. Frameworks that offer an object-oriented approach to artificial intelligence serve to raise the level [21,22].

3.3 Model of an automated educational and methodological complex based on a semantic network

The automated educational and methodological complex is a part of the academic discipline, the content of the educational and methodological complex, is created, stored, and communicated to the student in an understandable form using automated information technologies, and for the teacher, the creation of the educational and methodological complex is optimized. The educational material of such an educational and methodological complex should be presented structurally.

An important issue is the integrity of the subject area in which a diverse range of educational and methodological complexes are considered. A holistic view of the educational and methodological complex is being shaped and developed. At the same time, the learner can see the connection between the concepts of different educational and methodological complexes. This helps to ensure a holistic view.

The concepts of a semantic network are formed based on the requirements for an automated educational and methodological complex. One of the main issues is the choice of a basic model for a holistic view of the subject area. The semantic network is used as such a model.

In the literature, the words «semantic network» and «ontology» are found in sufficiently close contexts related to the field of knowledge engineering or the various sections of artificial intelligence as a scientific discipline. The semantic network is the most powerful class of mathematical models for representing knowledge of the subject area.

There are about 200 types of semantic relations in the literature. All of them are represented in natural language and have different properties from both mathematical and linguistic points of view. Developing a universal representation of a semantic network with so many types of relationships is a complex and time-consuming task. The network model of knowledge requires a unified method of a complex solution to problems of input and processing of knowledge, using means other than predicate logic, which is insufficient to support the linguistic component, and the organization of the interface [23].

In general, a semantic network is defined as a species structure:

$$S = \langle \mathrm{O.R} \rangle \tag{1}$$

Where S is the semantic network; O-multiple objects in the subject area; R - multiple relationships between objects.

The described semantic network of the subject area is called the semantic network of concepts of the educational and methodological complex. Thus, we will implement a holistic view of the subject area based on a semantic network of concepts. An important aspect is a relationship between objects. It is necessary not only to show the relationship of the objects in these relationships but also to clearly explain what these relationships are, to show their meaning and essence. For example, a hyperlink in

HTML is not a semantic relationship, as it allows you to go to another element, but does not explain how these elements are linked.

Consequently, the following requirements can be formulated:

- a holistic view of the subject area is a semantic network of concepts of the educational and methodological complex;
- understanding the meaning of the relationship between the concepts.

In this paper, the term "educational process" is analyzed in terms of general system theory. According to general system theory, the concept of "system" is defined as a set of interrelated and interacting elements, while the concept of "process" is defined as the transformation of a system. S^0-there would be Σ multiple elements of some system, β multiple operations defined on set - S^0. Then the system conversion means that $S^1 = \beta(S^0)$ where, S^1- Σ set of system elements, obtained by applying conversion β to the elements of the set S^0. The organization of the educational process where S^0 is a subset of the educational system elements corresponding to the students; β is a set of operations for the delivery of educational material; S^1 - persons who have completed training.

In the model presented in the paper, τ refers to the procedure for determining the level of competence of students. If the procedure τ applies to potential students S^0, it is called a preliminary test, if S^1 has completed the training, it is called a test passed. The objective of the training must be the result of a transformation of the system. If the G is the learning objective, the transformation rule in this model is recorded as follows:

$$S^1 = \beta(S^0, G) \tag{2}$$

$\varphi(\tau)$ refers to the functional competencies that make it possible to measure the level of competence of students, e.g. the percentage of correctly completed test tasks. While the learning efficiency:

$$\varphi\big(\tau(S^1)\big) - \varphi\big(\tau(S^0)\big) \tag{3}$$

Comparison of the results obtained after the transformation with the target usually shows some difference:

$$G - \varphi\big(\tau(S1)\big) \neq 0 \tag{4}$$

If this difference is greater than some possible errors, the training process can be repeated until the required level of competence is achieved.

Didactic materials are called reading elements:

1. formulation of the learning objective;
2. information materials;
3. tests, and questions to verify that the learning objective has been achieved.

The learning objective is understood as a clear statement of the requirements for knowledge formed in the course of training, which makes it possible to determine whether the learner is proficient or not. The complex educational elements form the educational module. In addition to the educational elements, the module must contain a statement of the learning objective related to the module and tests, questions, and problems to verify the achievement of this objective. The possibility of testing is not obligatory for the educational and methodological complex. There is also the possibility of working with control questions that help students in mastering the educational material.

Leading questions help the learner to understand the need to study a certain element, and confirmation questions help the learner repeat the knowledge he or she has acquired. Based on this information, the requirements for the instrument model can be formulated:

- formation of leading questions for the learner;
- correlation of the educational material with the concepts and relations of the system of semantic concepts;
- using learning objectives;
- the connection between the learning objectives and the semantic network of concepts of the educational and methodological complex;
- a holistic perception of the learner's achievements using the current knowledge model.

Considering these requirements, a model of an automated educational and methodological complex based on a semantic system of concepts may be proposed. The structural model of the automated educational and methodological complex is based on a semantic system of concepts. The main element of the presented model is a semantic network of concepts of the educational and methodological complex. The semantic network of concepts of the educational and methodological complex characterizes the information in the training manuals as links between different concepts. Concepts and relationships between concepts can refer to many control questions and many resources (URLs) related to concepts and relationships.

Educational and methodological complex - a multiplicity of learning objectives. The objective of education is to organize a set of concepts and relationships that are part of a semantic network of concepts of the educational and methodological complex.

A formal model of an automated educational and methodological complex based on a semantic network. If we define a semantic system of concepts of the educational and methodical complex:

$$TG = \langle TGT, TGR \rangle, TGT = \{tgti\}, TGR = \{tgrj\} \quad (5)$$

Where TG is a semantic network of concepts of the educational and methodological complex;

TGT - the main elements of the subject area in which the educational and methodological complex is being developed, many concepts;

TGR - relations between concepts, connections;

$tgti$ - the concept of the educational and methodological complex;

$tgrj$ - relations between concepts.

The multiplicity of educational and methodological complexes:

$$CRC = \{crs_i\}$$

Where, CRC - a multiplicity of educational and methodical complexes; crs_i – educational and methodical complex,

$$crs_i = \langle id, eid, crs_{NM}, LG\rangle, LG = \{lg_i\}; \quad (6)$$

crs_{NM}- the name of the educational and methodical complex;
LG - objectives of the educational and methodological complex;
lg_i - learning objective.

We define the learning objective as a set of concepts and relationships arranged in a semantic network of concepts of the educational and methodical complex:

$$lg_i = \langle id, eid, lg_{NM}, \{tg_i\}\rangle, tg_i \in (TGT \cup TGR), \quad (7)$$

lg_i – learning objective, lg_{NM} - the name of the learning objective, tg_i - an element of the learning objective that belongs to a set of concepts and interrelationships connected by a semantic network of concepts of the educational and methodological complex.

The educational and methodical complex of the discipline (EMCD) must have a title page and the following mandatory structural elements: lecture complexes, a plan of practical (seminar) classes, independent work of a student with a teacher, materials for independent work of a student, materials for evaluation and control of students' academic achievements, software and multimedia support for classes following the content of the discipline. The EMC of the discipline is prepared by a teacher (or a group of teachers) on behalf of the head of the department based on the above-specified documents. The standard procedure for approval of the EMCD: it is considered at a meeting of the department, coordinated with the methodological council of the faculty, where the discipline is studied, coordinated with the degree-granting department in the specialty (direction), and approved by the Chairman of the Council of the Faculty, Vice-Rector for Academic Work. The approved changes and additions are applied from 1 September of the new academic year. Compilation, coordination, approval, and process of changes, as well as receipt and registration of copies, control over the introduction of changes, exclusion, and storage of EMC of the excluded discipline, are determined by the current rules for the replacement of university documents.

The semantic network model consists of four components: Complex nodes representing real-world objects; Complex edges representing semantic relations between objects; Complex features denoting different types of semantic relations; Set of restrictions limiting semantic relations and objects.

The semantic networks show the different semantic relationships between concepts. Semantic relationships can be symmetrical and asymmetrical. Examples of symmetrical semantic relationships are synonyms and antonyms Despite the importance of synonymic relations in linguistics, there are different approaches to defining them [24,25].

To solve the problems of the integrity of the subject area considered in various educational and methodological complexes, a model of an automated educational and methodological complex based on a system of semantic comprehension has been proposed. The model contains a formal description of the concepts and relationships between the concepts, the educational and methodological complex, learning objectives, and control questions. The student's current knowledge model characterizes the extent to which the learning objectives of the educational and methodological complex have been achieved. The proposed educational and methodological complex makes it possible to develop a variant of the methodological complex based on a holistic view of the subject area.

Tools and technologies for creating information systems. At present, the term "learning object" is widely used in the object-oriented approach to the development of computer-based learning systems, but there is no clear definition of this term yet. Some authors understand quanta of the mind as an object of learning (OL), while others consider the object of learning at two levels: macro level (topic level) and micro level (Quantum level QL), but the course can be considered an object of learning. The main part of the program consists of the following modules: information, modeling, calculation, and control. The screen fragments that make up the main part of the program contain text and graphic information. Text information includes theory, formulas, explanations, instructions, explanations; graphical - diagrams, drawings of laboratory facilities, drawings, and animation clips.

The optimal sequence of objects to be surveyed is built based on a learning material model using oriented columns with loaded G(V, S) ribs (Figure 1). Most of the V tops of the graph correspond to the objects of study (courses, topics, chapters of topics, or mind quanta), and many s-edge connections. In this case, the following degree of communication can be achieved:

S_1- to study the object it is necessary to have a general idea of another object of study;

S_2- when researching an object, references to another object of research are often used;

S_3- to study more complex (or rarely used) concepts of an object, knowledge from another object of study is required;

S_4- to study the object and apply the knowledge in practice, a clear knowledge of another object of study is required;

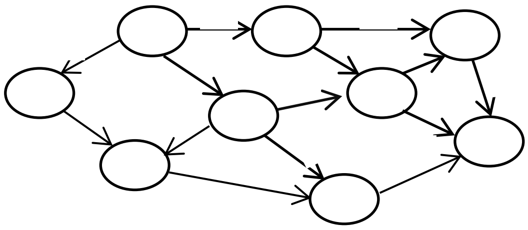

Fig. 1. Semantic model of the educational material

In each column i each element is placed according to the vector $V_i = \{R_{i1}, R_{i2}, \ldots, R_{im}\}$, which consists of four parameters.

$$R_{ij} = (p_{ij}, t_{ij}, z_{ij}, u_{ij}, q_{ij}) \quad (8)$$

where $i -$ number of LO; $j -$ number of the program (specialty) of the student; $p_{ij} -$ program (specialty) of the student; $t_{ij} -$ time of study of LO; z_{ij}, – level of knowledge of LO that can be achieved during the study; $u_{ij} -$ level of skills; $q_{ij} -$ level of skills that must be formed as a result of the study of LO.

Ontologies have become very popular with knowledge base developers, with the help of which it is possible to present an agreed system of concepts for a modeled field of knowledge.

4 Discussion

Semantic systems are informational graphics that include hubs and connections (circular segments or bolts) between hubs. Hubs speak to objects or concepts, and connections to connections between hubs. Thus, a semantic layout can be a coordinated diagram. When printing, the hubs are regularly processed in circles or areas, and the connections are drawn in the form of bolts between the circles. Primary computers use semantic systems for artificial understanding and machine interpretation, but the preceding forms have long been used in reasoning, psychology, and linguistics. The monstrous Worldwide semantic ranking map can be an expansive semantic network. Common to all semantic systems is an explanatory graphical representation that can be used to transfer information and strengthen mechanized thinking structures that are close to information. Some forms are purely random, but others are formally characterized by a framework of justification [15] [26].

Acceptance after - these are the six most common types of semantic systems: Network definitions emphasize a subtype or link between sorting concepts and the recently characterized subtype. Since definitions are adjusted by definition, the data in these systems is expected to be mostly correct. The claims organization is intended to approve recommendations. Not at all like systems, definitions, and data within the framework of explanations of an organization are considered conditionally correct if they do not have an unambiguous stamp of a modular administrator. Implication systems use the sentence as an essential relationship for interacting epicenters of activity [18]. They can use to speak with constructs of belief, causation, or reasoning.

Executable systems include several components, such as transferring tokens or related strategies that can conclude, send messages, or search for projects and associations. Training systems build or expand their views, getting information from the cases. Modern information can change the ancient organization by including and evacuating concentrators and circular segments or by changing the number. Hybrid systems combine two or more past strategies, either in the same organization, or in isolated, but closely associated systems. Some semantic systems were specifically planned to update theories around a person's cognitive tools, while others were created mainly for computational efficiency. In some cases, computational problems can lead to the same conclusions as mental evidence. The contrast between definitions and for illustration, overconfident systems has a close parallel with the contrast between semantic memory and long wave memory [27].

5 Conclusion

Computerized semantic systems are the representation of a set of concepts or the definition of the fundamental organization of concepts in training. Semantic systems require the study of the basic interaction between the conscious substances of students. When building semantic systems, doublers should be able to analyze the structure of their information, which can help them integrate modern information into existing information structures.

The result is a convincing use of the information received. Improving semantic systems requires reorganization of education, and a clear representation of concepts and associations between them, this will allow you to keep in mind and collect information, as well as increase the ability to apply information in unused conditions, combining modern concepts with modern concepts and ideas that promote understanding.

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