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The concept of personalized e-learning with the use of mobile applications based on ontologies

El concepto de e-learning personalizado con el uso de aplicaciones móviles basadas en ontologías

BAKANOVA, Anna Pavlovna 1; OKULOV, Sergej Aleksandrovich 2; CHUNAEV, Anton Vladimirovich 3; LOGINOV, Konstantin Viktorovich 4; SHIKOV, Aleksey Nikolaevich 5

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ABSTRACT:

The last few years can be described as "explosive" in the mobile application development market. There is a huge number of services, this trend affects the business community and the use of mobile technologies in all spheres becomes the norm. Under existing conditions of market relations, enterprises inevitably face the main difficulty - their competitiveness, which is strongly related to the qualification and level of personnel training. Heads of companies are fully aware of the fact that it is necessary to invest today in the development of the company and employees to be successful tomorrow. Top management understands the dependence of the quality of work of employees, departments, units, services and the company as a whole on the quality of training and qualification of personnel. For this purpose, corporate training systems are being developed, based on remote computer training technologies and the use of mobile means. The article describes the content of the developed concept of personalized corporate e-learning using mobile applications based on ontologies. It is concluded that it is crucial to create corporate knowledge bases and a corporate competence catalog. The relevance of building corporate learning systems based on the knowledge base, which is represented by ontologies,

RESUMEN:

Los últimos años pueden describirse como "explosivos" en el mercado de desarrollo de aplicaciones móviles. Hay una gran cantidad de servicios, esta tendencia afecta a la comunidad empresarial y el uso de tecnologías móviles en todos los ámbitos se convierte en la norma. En las condiciones existentes de las relaciones de mercado, las empresas se enfrentan inevitablemente a la principal dificultad: su competitividad, que está estrechamente relacionada con la capacitación y el nivel de capacitación del personal. Los jefes de las empresas son conscientes del hecho de que es necesario invertir hoy en el desarrollo de la empresa y los empleados para tener éxito mañana. La alta dirección entiende la dependencia de la calidad del trabajo de los empleados, departamentos, unidades, servicios y la empresa en general en la calidad de la capacitación y calificación del personal. Para este propósito, se están desarrollando sistemas de capacitación corporativa, basados en tecnologías remotas de capacitación informática y el uso de medios móviles. El artículo describe el contenido del concepto desarrollado de e-learning corporativo personalizado utilizando aplicaciones móviles basadas en ontologías. Se concluye que es crucial crear bases de conocimiento corporativo y un catálogo de

that allows you to create educational objects of different levels and complexity is explained. The analysis of the identification of individual characteristics and preferences of employees for training and advanced training represents the great interest, as well as experience in managing intellectual assets of leading companies. It is proposed to integrate LMS with the corporate knowledge base in order to increase efficiency and lack of duplication of information, so that training courses can be created from the available articles. This allows to significantly reduce the time for the preparation of e-learning courses, improve the efficiency of corporate training and reduce the costs of retraining and upgrading the skills of staff.
Keywords: e-learning, individual learning paths, personalized corporate training, ontologies, mobile applications

competencias corporativas. Se explica la relevancia de construir sistemas corporativos de aprendizaje basados en la base de conocimiento, que está representada por ontologías, que le permite crear objetos educativos de diferentes niveles y complejidad. El análisis de la identificación de las características individuales y las preferencias de los empleados para la formación y la formación avanzada representa el gran interés, así como la experiencia en la gestión de los activos intelectuales de las principales empresas. Se propone integrar LMS con la base de conocimiento corporativo para aumentar la eficiencia y la falta de duplicación de información, de modo que los cursos de capacitación se puedan crear a partir de los artículos disponibles. Esto permite reducir significativamente el tiempo para la preparación de cursos de aprendizaje electrónico, mejorar la eficiencia de la capacitación corporativa y reducir los costos de capacitación y actualización de las habilidades del personal.
Palabras clave: e-learning, rutas de aprendizaje individuales, formación corporativa personalizada, ontologías, aplicaciones móviles

1. Introduction

To increase their own efficiency, each company conducts activities to train and develop its own employees. Undoubtedly, the scale of these activities is directly related to the size of the company and its financial performance. Small businesses prefer to hire specialists with the necessary competencies at once, medium-sized companies, in most cases, use the resources of the HR department to organize the required training, and large companies build complex systems of training and retraining of employees. Surely, in each case there are exceptions that are related both to the scope of the company's activities and to the attitude of its management to the issue. If heads of companies’ do realise the importance of training and do not want to allow potential losses due to the incompetence of employees, training in the company becomes regular. Otherwise, there may be situations in which problems will not arise until the departure of one of the employees will not be a major blow to the company's activities. All the experience that he possessed, all his knowledge and business connections will be lost to the company. It is likely that the withdrawal of an employee from one of the key positions in the company may entail its complete disappearance.

2. Materials and methods

The concept of an integrated system of corporate training

One of the possible solutions to this type of problems is the formation of a library of useful information that is needed within the framework of the company's activities. This information can be attributed, for example:

1. Regulations of work.
2. Information on products or services.
3. Contacts and data of suppliers, contractors and customers.
4. Ways to solve the problems.
5. Financial indicators.
6. Analysis of project activities.
7. Etc.

Each particular company has its own information artifacts, which must be stored. Moreover, employees need to be encouraged to formalize and retain their professional knowledge and experience in the same library. Any employee of the company, in agreement with the responsible person, can access the information he needs, if it is available. Given the level of technology development, it is not difficult to create such a system, however, every company fully realise their own expectations from it. In companies with more than a few dozen employees, difficulties arise with the exchange of information. Each generates certain

information and stores it in a shared store. The amount of information grows, it is updated regularly, and the employees that are interested in it should know about it. A simple fixation and storage of information in some database is no longer enough. It is necessary to provide access to it at a specific moment when it is needed. The built-in processes within the company imply specific stages of implementation, for which specific data may be required, which in a common database can be searched for a long time. Accordingly, you need not just a storage tool, but also a decision support tool, which can also notify you of new information sets or about updates. After creating such a storage, the question arises: how to keep it up-to-date? To solve this problem, you can use the following approaches:

1. a centralized approach to updating information;
2. a decentralized approach to updating information;
3. a hybrid approach to updating information.

The main feature is the tasks for the employees of the specialized unit:

1. coordination of works on actualization;
2. verification of new information and changes;
3. development and improvement of the information management process;
4. counseling and training of other employees.

A similar approach initially appeared in Japan and is still being used to manage intellectual assets of companies. The direction itself was called "knowledge management" [1].

It can be concluded that a well-established process of filling and updating the corporate knowledge base can already provide a good basis for a corporate learning system. Since all the important data for the company's work is contained in one database, to which all employees have access, the learning process, for the most part, consists in reading and additional consultations with specialists. For some companies this is more than enough. However, there is one more aspect that should be considered: information concerning the employees themselves, their positions and roles. It's not a secret that lack of career prospects can serve as a sufficient reason for an employee to leave the company, so companies are doing their best to offer their employees, both new tasks within the occupied positions, and career development options. All these opportunities should be as transparent as possible, for which the requirements for each post are formalized, described and placed in an accessible location, for example, in the same knowledge base. Thus, each employee can independently study the posts he is interested in and identify areas of growth for himself.

It is important to set the task of creating a corporate competence catalog. Using formalized requirements for posts, a list of all necessary competencies is compiled, which are then combined into thematic blocks, for example:

1. product management;
2. software testing;
3. software development;
4. installation and installation of equipment;
5. sales;
6. technical support;
7. etc.

Employees can independently choose for themselves the direction of interest and develop in it, and the company gets the opportunity to use the internal resource to close the emerging vacancies. It should be noted that in addition to job duties, an employee may have one or more additional roles in the company, for example:

1. mentor for new employees;
2. organizer of corporate events;
3. coordinator of sports sections;
4. speaker at events;
5. expert on certain issues;
6. etc.

Each role implies the possession of a certain set of competencies, which can also be stored in the knowledge base. Similarly, with competencies for positions. If the company clearly

spelled out the requirements for employees in a certain position, then it is easier to choose a replacement for them.

After a detailed study of the requirements for employees, it is necessary to create an instrument that will allow them to build their own development plans and track the results. You can call this the individual paths of development. Paths can be applied to both existing employees of the company, and for newly recruited into the company. For new employees, the algorithm is simple:

1. The applicant is selected for the vacancy for the requirements (competencies) for a particular position. His competencies are checked for compliance with the company's "competence catalog.»
2. If the applicant meets all the requirements, then he goes on probation. The trial period itself is a period of revealing the characteristics of the new employee and his prospects for working in the company.
3. During the probationary period, the employee receives the knowledge and skills necessary for the work, and after his successful passage he is free to choose the path of further development and the existing list of roles and positions.
4. Together with the manager, certain control points are appointed, in which the employee must demonstrate the results of his development.
5. As soon as the employee's knowledge and skills allow him to perform new duties, he can either be transferred to the personnel reserve, or assign him an additional role, or, if possible, transfer to another position.

For employees already working in the company, you can immediately create individual paths and proceed to their implementation. Development of an individual path is very time consuming and expensive, therefore it requires special competencies and resources. It is possible to reduce and simplify it by using the system of formation of individual paths.

Under the training path in this case is understood a consistent plan for acquiring new competencies by the employee of the company. It should be noted that this plan must necessarily be coordinated both with the employee himself and with his supervisor. It is necessary to use the company's resources as efficiently as possible and not spend it on developing competencies that the employee does not want or cannot use. It is not uncommon for staff to be transferred to new positions that do not suit them for any personal characteristics. For example, a professional engineer has established himself as an excellent performer, and the head of the division decided to transfer him to a managerial position. Not having the desire to organise the work of subordinates and solve accounting issues, the employee copes badly with new duties.

As a result, the company lost an excellent performer and acquired a mediocre manager. The advantage is lost. The same examples can be found with horizontal mobility of employees. To reduce the likelihood of this outcome, it is necessary to take into account the individual characteristics, preferences and inclinations of employees. In many companies, candidates for promotion are required to undergo a selection procedure, according to which they are admitted or not allowed before training the new competencies required in the new position [2]. If the candidate does not possess the required qualities, the company will not spend money on his training in this direction. It can be assumed that over time the employee will be able to develop the required qualities on his own and his candidacy can be re-examined for improvement, therefore the procedure for evaluating employees must be held regularly.

Identification of individual characteristics and preferences of employees should occur as soon as possible, or at least after successful passing of probationary period. At this stage, a basic profile of the employee is formed, which will be the starting point in his development - the beginning of the individual path. Then, based on the information received, possible ways of development, specification of control points and the results that should be demonstrated, as well as the search for sources of necessary knowledge and skills are being determined. To simplify the last process, it is possible to list the key competencies of the company's employees in the same knowledge base, which will allow all interested people to contact experts directly, and companies will find the resources required for solving the arising tasks faster.

Development and training of employees can be divided into the following areas:

1. Product (product training) - is aimed at studying the company's products;
2. Service (service training) - is aimed at studying the ways and tools for servicing the company's products and providing technical support for them;
3. Hard Skills (instrumental training) - is aimed at forming the competence of working with equipment, developing software, using third-party application packages, etc .;
4. Soft Skills (skills training) - is aimed at developing personal qualities and skills, for example: negotiations, public speaking, communication with the customer and the team;
5. Strategy (strategic training) - is aimed at training the company's leaders and the personnel reserve;
6. Standard (training in performance standards) - is aimed at teaching principles and rules of sectoral activities, contracts for the provision of services, etc.
7. Regulations (regulatory training) - is aimed at training the internal regulations of the company.
8. Commerce (commercial training) - is aimed at developing sales skills, both in general and specific products.

For each of the directions in the company, a curator can be appointed who will help to develop methodological materials, train employees and help solve emerging problems. Usually, a curator is a recognized expert in the corresponding direction.

These directions can serve as guidelines for choosing the development path for employees. Direct determination of the personal qualities of the employee can be carried out on the basis of the 16 factorial questionnaire of Raymond Bernard Cattell [3] (Form C).

A multifactorial personality questionnaire was published by Raymond Bernard Cattell in 1949 and has since been widely used in psychodiagnostic practice. The test was developed using factor analysis of a large number of personality traits, resulting in indicators that most accurately reflect different personality traits and create the most complete personality structure. In all, 16 primary factors were isolated by Raymond Bernard Cattell.

Based on the analysis of the results obtained, a personal profile of the employee consisting of 16 scales will be available, each in numerical equivalent shows the severity of his specific personal qualities.

To identify professional inclinations, a questionnaire of professional preferences (adaptation of John L. Holland's methodology) can be used, since it also contains a special section devoted to the aspects of the future career of the interviewee [4].

The technique was developed by the American psychologist John L. Holland. He created the model RIASEC, which describes simultaneously the type of personality and the type of activity to which a person of this type has the greatest propensity, predisposition, ability.

Initially, the subject is asked to select from the list the types of activities that suit him, like him, or it seems to him that they will fit, regardless of whether he is able to do it or not (11 types of activity of each of the 6 types are proposed). Then the subject should note his abilities - the kinds of skills that he possesses and which can apply competently (from 11 types of skills for each type). And then he chooses the careers he is interested in, even if he was not engaged in these activities (it is offered for 14 careers for each professional type).

The experimenter sums up the scores obtained in the three investigated spheres for each type, and then compiles a professional personality profile, highlighting the 3 prevailing professional types (it is especially important to consider their order). Using the presented questionnaire, it is possible to identify the field of activity to which the employee is predisposed, and thereby determine the list of posts or roles that can be recommended to him.

Another crucial factor is employee's motivation. To determine it, you can use the technique to study the motivation of Shane's professional career, as well as the methodology for studying the factors of the attractiveness of the profession [5].

The method of Edgar H. Schein is a list of questions aimed for diagnosing the value component of professional activity. The translation and adaptation into Russian were carried out by V.E. Vinokurova and V.A. Chicker. Another name for the technique is "Career Anchors".

The questionnaire includes 41 statements, the degree of their agreement with each of which the respondent should evaluate on a 10-point scale. Points are grouped into 8 scales representing 8 non-mutually exclusive career value orientations («career anchors»):

1. Professional competence.
2. Management.
3. Autonomy (independence).
4. Stability.
5. Service.
6. Call.
7. Integration of life styles.
8. Entrepreneurship.

Using the obtained profile of the employee and the direction he wants to develop in, you can develop it with less risk. Moreover, using the apparatus of the Bayesian classifier, it is possible to offer assessments of employee success in several directions in order to determine the path with greater chances of success.

A small result on the state of affairs in the company under investigation:

1. The company has an extensive knowledge base with information on various aspects of its products.
2. In the knowledge base, a catalog of competences is stored with reference to specific positions and roles.
3. For each employee, a basic profile is formed, which takes into account personal characteristics and preferences.
4. The company has allocated 8 areas of training, each of which assigned a responsible curator.
5. Employees form individual development trajectories and with their help acquire new competencies.

The issue is that the learning process has not been described. Ideally, it is necessary to develop training programs for each role and position, prepare test materials and practical assignments, and form a training and consultation schedule. This approach is unreasonably expensive for many companies, so it is reasonable to approach the scale and sequence of doing such work.

Certainly, the acquisition of some competencies requires direct interaction of employees, but the overall processes of coordination, information exchange and advice should be transferred to a special information system related to the class of learning management systems (LMS). These systems allow monitoring the progress of students, providing them with access to training materials, communicating with teachers and performing test and practical assignments. The employee himself can see the progress of training, request and plan consultations, and also adjust his own development path, by adding or replacing the thematic blocks. In turn, managers can assess the speed of mastering new competencies by employees, study their practical and test tasks, receive feedback on staff from teachers and coordinate changes in individual plans of employees. A large number of similar systems are described on the portal capterra.com [6].

For greater efficiency and lack of duplication of information, it is possible to integrate LMS systems into a corporate knowledge base so that training courses are immediately created from the available articles. This feature allows you to reduce the number of iterations in the process of updating information, because the changes in the articles will immediately appear in the courses.

The process of assigning new competencies to an employee should be related to its demonstrations of a specially selected commission from among the experts of the relevant field. Adding competence to the profile of the employee should be made either by its manager or by the curator of the direction, which will avoid conflicts or delaying the process due to the absence of any employee.

It is necessary to take into account the schedule of employees and their unofficial affairs. Not every employee has the opportunity to regularly devote time to his development at home or at work, so the process of learning new information and passing various tests can be transferred into mobile platforms, just as communication with colleagues and teachers.

The best possible result will be the creation of a common informational environment, including corporate information resources and a set of devices for accessing them: smartphones, tablets, workers' computers, interactive simulators, etc. Also, you should not disregard the formats of remote learning: training video clips, webinars and third-party profile resources of the Internet.

Appliance of ontologies while creating corporate e-learning systems

Ontology is attracting increasing attention as a tool for modeling and constructing logical reasoning on the basis of contextual information, which determines the wide use of their application in e-learning. Within this paradigm, the ontological Web language recommended by the W3C for creating and distributing ontologies is used as the basis for the approach in describing the necessary elements (events, objects, locations), their logical associations and the background information required to obtain additional information [7].

The advantage of using ontologies in e-learning systems is:

- Availability of a common understanding of the information structure among users and software agents.
- Ability to reuse knowledge of the domain.
- Ability to make domain definitions explicit.
- Separate domain knowledge from operational knowledge.
- Knowledge domain distribution [8].

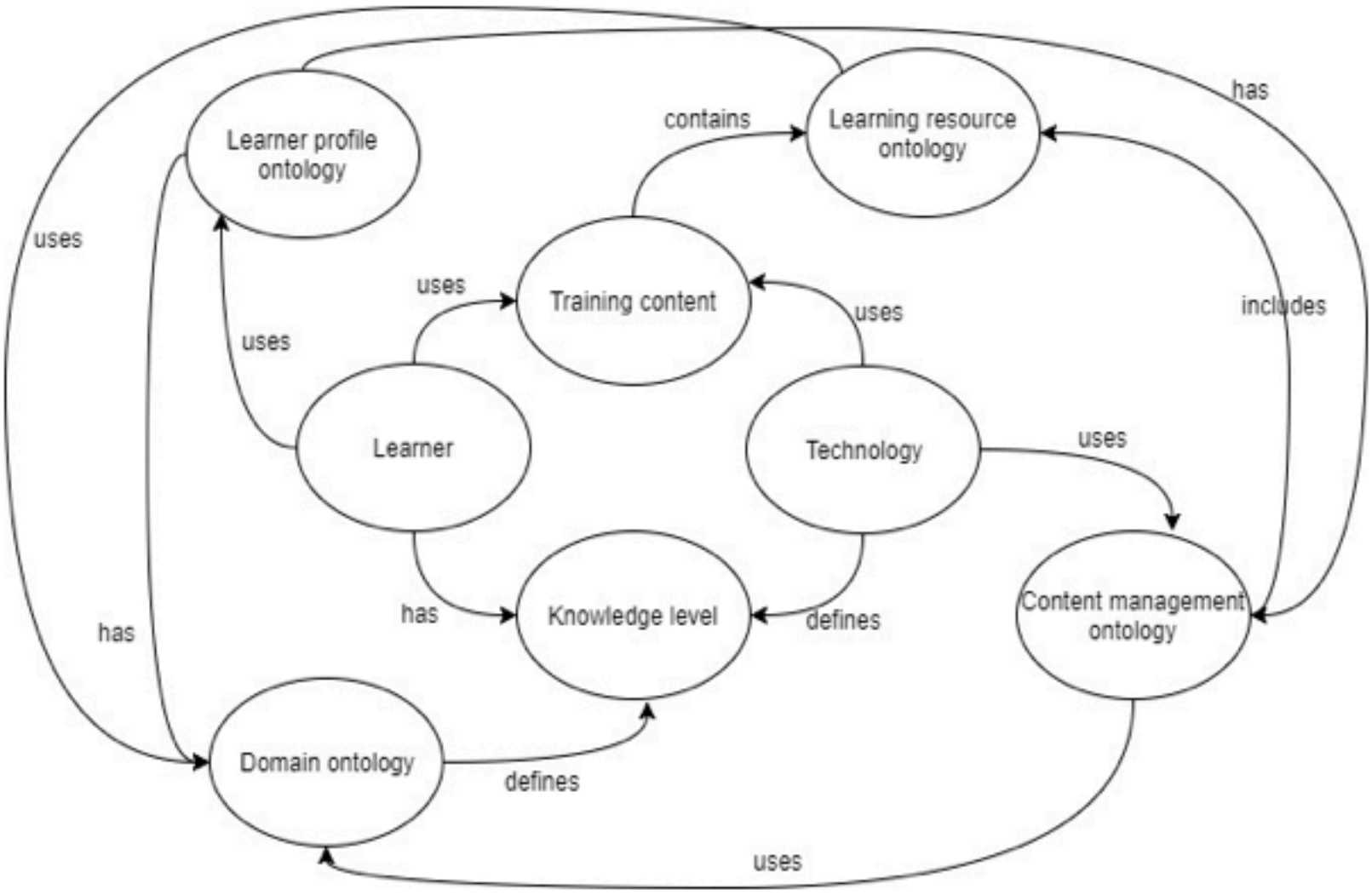
Therefore, it is advisable to implement e-learning systems based on one or more ontologies into corporate training. They index the documents and thus assign a destabilization of the classical learning content [9]. That, in turn, is necessary for searching data on the basis of semantic criteria, that is, intelligent search. The main content of the ontology is the result of extracting knowledge from a number of documents manually, which is the result of the daily work of participants in e-learning [10].

The creation of an ontology simplifies the search and navigation in educational content, taking into account the knowledge acquisition, ensures their reuse, and the delivering of learning patterns. By reason of supplement metadata to the document capitalized through the e-learning platform, we add a semantic description to the organizational memory [11]. As a result, another level of data structuring is developed, due to the semantic relationships between terms (works with, is associated with, is a component, is a participant, interacts with, the premise for, replenishes, etc.), it becomes possible to create complex queries.

These predominant features, provides an opportunity to create a new standard of personal e-learning. The user can build his own learning path himself, excluding redundancy of information, avoiding unnecessary subjects, is able to create an individual template and save it for further training. At the same time, each user has free access to a structured knowledge base.

Thus, the scheme of personalized corporate training using ontologies in e-learning systems looks as follows (Fig. 1)

Fig. 1
Flow diagram of personal corporate training using ontologies in the e-learning system

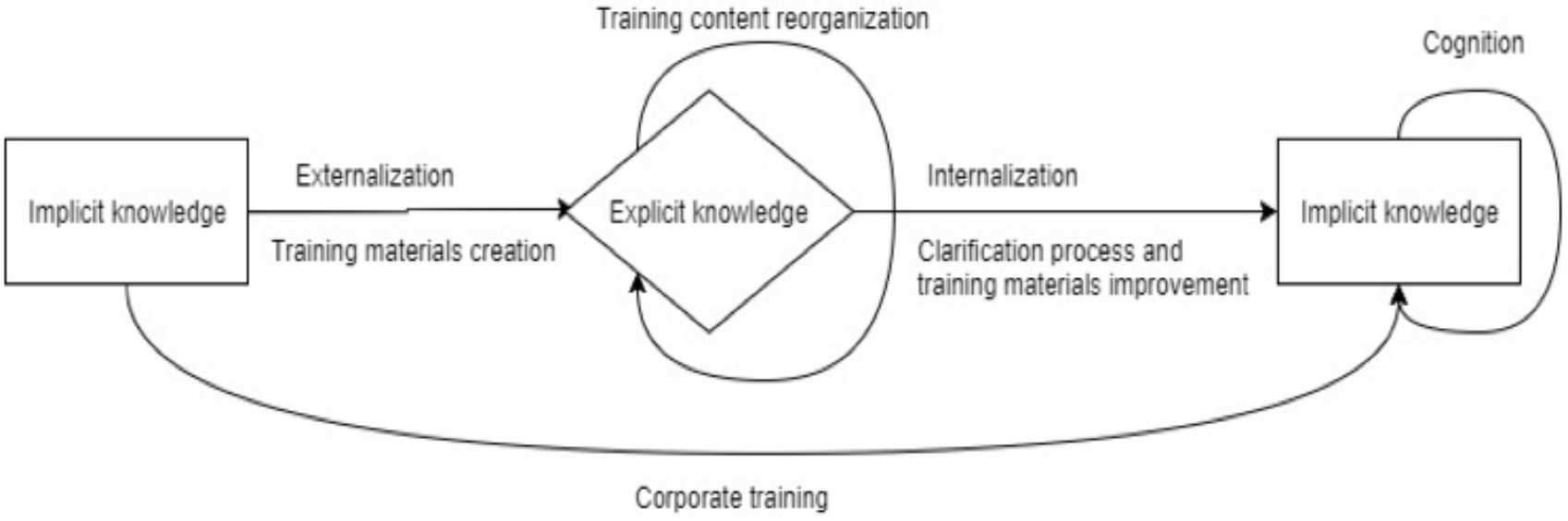


The consistency is established between these ontologies for the integration of knowledge into a database of flattened and semantically valid data [12]. This approach renders possible to add new data to the system while maintaining a modular concept and to be persistable to changes in the data source. An important advantage of this approach is the variety of the data extraction from each ontology, relative to the semantics corresponding to the previous ontology [13].

In addition to explicit information: specific facts, definitions and data that can be filled with ontologies, there are also implicit knowledge - problem solving, action algorithms for a specific situation. This knowledge is possessed by the employee, but it is impossible to place them in the knowledge base as a concrete term or concept. Thus, organizational knowledge depends on individual knowledge, and therefore, mechanisms are necessary to stimulate the dissemination of individual knowledge.

In terms of a knowledge base, which is represented by ontologies in the learning system, you can create educational objects. That is, the combination of various elements of explicit knowledge to convert implicit knowledge into a specific information. In order to extract it then from the repository on demand of the user in the original form of implicit knowledge, experience, skill. In this case, any type of information can be used as an explicitly defined knowledge in an ontology. This process is shown in Fig. 2.

Fig. 2
The process of complex content of the corporate e-learning system developing



3. Discussion and conclusions

The proposed concept of personalized e-learning with the use of mobile applications based on ontologies reveals the modern approach to the organization of learning processes in small enterprises of various branches. This does not imply the necessity for widespread use of mobile e-learning applications.

For the entire group of branches of industrial production the most efficient way of learning is the traditional full-time training under the guidance of a teacher or a trainer. Feasibility of implementing an e-learning in the corporate training system is one of the directions of further research. Preliminary data from our studies show that the effectiveness of e-learning in selected areas is not more than 10-12%. There are many reasons for the unsuccessful use of e-learning in corporate training systems and it is crucial to correctly interpret and take them into account when designing and organizing vocational education and training, and not to follow blindly the general trends and fashion.

4. Results

Using all the available arsenal of mobile personalized corporate training you can achieve significant results in the effectiveness of staff training, reducing costs for training and staff development. Ontological approach and the use of individual learning paths are the most popular and effective technologies for planning and conducting corporate training.

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1. Master of Science, Saint Petersburg national research university of information technologies, mechanics and optics, Saint Petersburg, Russia

2. Master of Science, Saint Petersburg national research university of information technologies, mechanics and optics, Saint Petersburg, Russia

3. Master of Science, Saint Petersburg national research university of information technologies, mechanics and optics, Saint Petersburg, Russia

4. Master of Science, Saint Petersburg national research university of information technologies, mechanics and optics, Saint Petersburg, Russia

5. Associate Professor, doctorate of Technical Sciences (Ph.D.) Saint Petersburg national research university of information technologies, mechanics and optics, Saint Petersburg, Russia

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