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Semantic modeling for education of library and information sciences in Iran, based on Soft Systems Methodology

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Abstract

Reviewing the recently published texts in the field of library and information science education indicates some fundamental problems in this pedagogic process. According to different factors dealing with the process, confronting the challenges is considered as complex issues. Therefore, in this research Soft Systems Methodology, an action research method, was chosen to propose a comprehensive model to solve the mentioned problems. Based on the Checkland seven proposed stages, the problem situation was identified, and then it was expressed in the form of a rich picture. Driving root definitions and the CATWOE model were cleared to accomplish the conceptual model. Comparison of the conceptual model to the real world, also proposing feasible and desired changes are the fifth and sixth stages of the research. Finally, taking action to improve the current situation in the field of LIS education finished the procedure. Utilizing the steps of Soft Systems Methodology, this research draws the rich picture illustrating the process of LIS education and its issues dealing with the related ecosystem. Accordingly, the final model consisting of three ontologies was attained. To validate the semantic model, Cohen's kappa coefficient was calculated. The model, approved by high level of expert agreement, not only can be an appropriate solution for the problems involved in library and information science education in Iran, but also can be considered as a pattern for future researches in designation and implementation of a semantic model of education in other disciplines.

Keywords

Adaptive model, educational model based on ontology, library and information science, semantic model of education, semantic pattern of education, Semantic Web technologies, Soft Systems methodologies, Web3 technologies

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Introduction

In the world today, the educational system, particularly higher education, has a direct relationship with the comprehensive development of communities. In

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other words, there is an intimate dependence between the growth and progress of communities on one hand and the growth and advancement of their higher education system on the other hand (Brennan and Shah, 2011).

Therefore, investment in universities and centers of higher education is considered as one of the most important types of long-term investment in different countries. In this regard, the investment for the training of experienced manpower is reckoned in different arenas such as social, cultural, economic, industrial sectors all over the world (Horri, 2006).

Academic education aims to train people who can live wisely in the increasingly changing world. Achieving this goal, universities should focus on teaching-learning strategies (Adali and Silman, 2009).

The available evidence indicates that higher education in Iran has met some problems in designing and executing curriculums. Obviously, to accomplish a learning community and breed lifelong learners, the institution should review its own syllabus and also identify obstacles in order to overcome them now more than ever (Karimi and et al., 2014).

Library and information science (LIS), a domain of higher education in Iran, has faced abundant fluctuations since the beginning of its official foundation in the 1970s until now. Accordingly, its curriculums have been dramatically changed based on necessities or personal interests. Whereas educational programming has several disadvantages and advantages in this field (Horri, 2006: 207), recognizing the weaknesses and finding appropriate solutions will cause the majority to progress.

Problem statement

Information science as a subsystem depends on a more general system, Iran's educational system. Therefore, social, economic, cultural, and political issues of the educational system on a macro-level determine the conditions of subsystems in the micro-level such as information science. The Iranian educational system, even at the higher levels, is still steeped in old-fashioned models and paradigms (Heidari, 2011). The absence of organic relationships among different educational levels and elements and the lack of cohesive programming and dynamic educational systems are noted as other deficiencies of LIS education by Heidari (Heidari, 2011: 17; Radfar, 2011). In addition, the existence of old learning references and resources used by an Information Science department, along with neglecting the (public) services available in the syllabus, is warned against by other experts (Eltemasi and Fahimnia, 2014).

Although the Committee of Library and Information Science – which belongs to the Supreme Council of the Ministry of Science, Research and Technology – made some influential attempts to improve the information science educational system (such as a comprehensive review of the syllabus in 2009 and then 2014), the lack of attention to the design of a systematic framework based on a special philosophy is still considered the main challenge in this domain (Geraei and Heidari, 2016). This study aims to systematically review the relevant resources in information science education and provide a rich picture of the current status in this area. On the other hand, the authentic and updated texts pertaining to educational works were studied to provide an effective model in overcoming the mentioned issues. In this regard, emphasizing the usage of new educational technologies (Amir and Jelas, 2010) and recommending the powerful tool of knowledge organization (Zeng, 2008) – which enables the analysis of knowledge, formulating terms and their relations, reconstructing knowledge, and disseminating and sharing the general understanding of a knowledge structure amongst individuals (Kafashan and Fattahi, 2011) – put forward the terms ontology and Semantic Web. This proposed educational model, benefiting from semantic capabilities, can indicate the key elements of an educational system in an integrated way (Levison et al., 2012). Also, based on metadata, semantic and ontological relations and the power of efficient organization, it can impressively improve the learning process (Jashapara, 2009). Therefore, this research can offer an effective solution to the problems mentioned and improve the process of teaching-learning in LIS on one hand, and introduce a new chapter of educational models based on ontologies in various disciplines of Iran's higher education.

Citing the original texts, the properties of a semantic model of education are considered as the solution to the problems mentioned in Table 1.

Literature review

Literature review of LIS education in Iran

Educational topics and issues related to information sciences have been noticed by researchers since the official establishment of this field in Iranian universities. Most of the researchers have confirmed the necessity of deep changes and reforms in the structure and curriculum of information science education.

The studies conducted by Ganjian (1974) and Ebrami (1975) can be regarded as the first works in this field (Fattahi, 2005). Many researchers (Eltemasi and Fahimnia, 2014; Fattahi, 2000; Hayati, 1999;

Table 1. Problem statement.

Row	Mentioned problem	The problem citation	Property of semantic model to solve the problem	The property citation
1	Absence of organic relationship among different educational elements	When the absence of an organic relationship among different educational elements is considered as a big obstacle for educational efficiency (Heidari, 2011).	Providing adaptive educational systems (i.e. domain, user and context) and representation of various types of knowledge driving the process of adaptive learning, and their interaction when generating the concrete instances of adaptive learning design dynamically (Kravcik and Gasevic, 2010).	Semantic web technologies can improve reusability and interoperability of each model of an adaptive educational system, focusing on pedagogical (instruction or activity) and adaptation models (i.e. procedural knowledge), and other models of adaptive educational systems (i.e. domain, user, and context). Also, Semantic Web provides solution of the current reusability and adaptivity issues, the representation of various types of knowledge driving the process of adaptive learning, and their interaction when generating the concrete instances of adaptive learning design dynamically (Kravcik and Gasevic, 2010).
2	Traditional and old-fashioned models and paradigm.	Educational system of LIS in Iran, even in high levels, is based on traditional and old-fashioned models and paradigms (Heidari, 2011).	Semantic Web and ontologies, are noted pivotal in new paradigm of interoperability and reusability in human-machine accessible systems.	Using human-machine accessible systems which represent educational components and their relations, especially Semantic Web and ontologies, are noted pivotal in a new paradigm of interoperability and reusability of educational resources (Boot et al., 2008).
3	Necessity of deep changes and reforms in the structure and curriculum of Information Science education	Most of the researchers have confirmed the necessity of deep changes and reforms in the structure and curriculum of Information Science education in Iran (Geraei and Heidari, 2016).	Representation of formal knowledge by Semantic Web technologies to facilitate the teaching-learning process in recent educational systems.	Today, many educational theories insist on representation of formal knowledge by Semantic Web technologies to facilitate the teaching-learning process in educational systems (Sicilia et al., 2011).

(continued)

Table 1. (continued)

Row	Mentioned problem	The problem citation	Property of semantic model to solve the problem	The property citation
4	Lack of attention to designing a systematic framework based on a special philosophy are considered as the main challenge in this domain (Geraei and Heidari, 2016)	The lack of attention to designing a systematic framework based on a special philosophy are considered as the main challenge in this domain (Geraei and Heidari, 2016).	A structured framework of educational capabilities including learning scenarios, human elements and pedagogic processes.	An important part of adaptive curriculum in the 21st century is based on Semantic Web technologies specially which provides a structured framework of educational capabilities including learning scenarios, human elements and pedagogic processes (Johnson, 2016).
5	Loss of a comprehensive and clear picture reflecting topics and sub-topics in LIS field	Loss of a comprehensive and clear picture reflecting topics and sub-topics in this field and a presence of general ambiguity in the internal atmosphere of LIS society (Fadaei et al., 2014).	Subject ontologies represent concepts, major and minor topics in scientific disciplines and make relations among them in a structured framework.	Subject ontologies represent concepts, major and minor topics in scientific disciplines and make relations among them in a structured framework by providing knowledge structure (Miranda et al., 2016).
6	Presence of a general ambiguity in the internal atmosphere of LIS society (Fadaei et al., 2014).	There is general ambiguity in the internal atmosphere of Library and Information Science's society (Fadaei et al., 2014)	Presenting educational goals, attitudes, skills, knowledge, experiences and learning activities (Miranda et al., 2016).	One of the major capabilities of ontologies in different systems presenting educational goals, attitudes, skills, knowledge, experiences and learning activities (Miranda et al., 2016).

Heidari, 2011; Kowkabi, 1997; Mokhtari, 2005; Tahavori, 2006) have expressed the emergence of a fundamental alteration in the educational system of information sciences in different languages.

Kowkabi in research titled "A glance at syllabus of Organization of Materials" studied the content of that syllabus for Associate and Bachelor's degrees in LIS. The findings indicated the absence of an updated syllabus, absence of a logical relationship among headlines and inattention to organization of electronic resources (Kowkabi, 1997). Reviewing different periods of information science education in Iran, Hayati (1999) considered an unusual focus on practical aspects, inattention to theoretical principles and lack of research-based attitude as the main problems involved with the field. According to the changing environment and society, Tahavori, in her research, considered a fundamental amendment of educational resources inevitable to train experts compatible with the alterations. Information technology, Electronic references, Organization of electronic materials, Research methodology in Information Sciences and Principles of Information literacy were proposed as the new syllabi in this field (Tahavori, 2006).

Lack of cohesive programming and a dynamic educational system in the professional society of LIS, neglecting the role of research in the learning-educating process, unnecessary emphasis on memorizing and sovereignty of an old-fashioned paradigm were listed as the key problems of LIS education in Iran (Heidari, 2011).

Geraei and Heidari (2016) proposed the theory of Core Competencies as an ideal model for educational programming in LIS to overcome some serious obstacles, such as: insufficient skills, capabilities and competencies of graduate students; the absence of dynamic programming; and the loss of a comprehensive pattern referring general and specific competencies necessary

for the increasingly changing society of information sciences. In another study, Geraei and his colleagues reviewed resources, surveyed and analyzed a matrix of direct influences to foresee the future of LIS education. They considered the attention on revising the structure of research and education in humanities and social sciences, status of the discipline in public opinion, specialism in educational programming, knowledge-based new job opportunities, and educational improvement of faculty members to be the most influential factors in the future of LIS education (Geraei et al., 2017).

Literature review of semantic technologies (ontologies) in educational, learning systems

A new concept of ontology (beyond philosophy) has emerged since the 1990s in scientific works by Sowa (1992) and Gruber (1993) dealing with various fields including Computer Sciences, Information Sciences, Artificial Intelligence, Linguistics, Knowledge Engineering, NLP, etc. (Hosseini Beheshti, 2014). The study by Stojanovic et al. (2001), titled "eLearning based on the Semantic Web" is considered as the first published work linking the topics related to procedures, elements and systems of education, and learning and teaching to semantic technologies. The results indicated that semantic architecture enhances educational content with formal semantics, which enables better possibilities for navigating through cyberspace and accessing its contents. It is primarily centered on ontology-based descriptions of content and the context and structure of learning materials, and thus provides flexible and personalized access to these learning materials. After issuing the first documents, the appearance of Semantic Web and ontologies in educational domains has increased by the presentation of various articles in national and international conferences, books, theses, and periodicals. According to a large number of works published in this area, this study points to some authentic and recently issued journal articles indexed in key databases (Elsevier, Science Direct, Eric, IEEE). To identify the learning style of learners, propose compatible educational content with them, and design the related curriculum, Vesin et al. (2012) implemented Protus ontology. This entailed the use of ontology and adaptation rules for knowledge representation and inference engines for reasoning to share, reuse, and create knowledge in the process of education. Icoz et al. (2015) introduced student-made ontologies as an influential tool to represent knowledge conceptualizations. Defining key concepts and their relations between each other establishes the backbone of the learning system. The system guides an individual student through his/her course by evaluating their progress and suggesting instructional material to review based upon their answers. Three main tasks are performed within this framework: building ontologies for the course, measuring a student's understanding level for the concepts, and making personal suggestions to create an individualized learning environment. The Icoz et al. (2015) paper presents: the integration of ontologies, assisted with student data, together with an intelligent Recommendation Module for the development of an E-learning system; the comparison and correction adaption of ontology from students' mind maps; and the assessment of students' actual weaknesses in comparison to what the Recommendation Module suggests. Romero et al. (2015) concluded that the use of ontologies as tools to guide the generation and the organization and personalization of e-learning content, including e-assessment, has drawn the attention of researchers because ontologies can represent the knowledge of a given domain, and researchers use the ontology to reason about it. This paper presented progress in the development of an ontology network, called AONet, that conceptualizes the e-assessment domain with the aim of supporting the semi-automatic generation of assessment, taking into account not only technical aspects but also pedagogical ones. Miranda et al. (2016) emphasized subject ontologies as a crucial aspect in engineering knowledge-based educational environments to enable the semantic organization and search of resources to support personalization and adaptation features for learning and teaching experiences. The paper focuses on SKOS for storing and accessing in order to support the knowledge sharing, knowledge reusing, planning, assessment and customization processes related to learning scenarios.

Insisting on designing and utilizing learning systems based on the learner's personality traits, Labib et al. (2017) introduced the learning environment suitable for as many learner models as possible. The researchers concluded that a Learner's Characteristics Ontology helps instructors to improve and personalize the learning content, can recommend learning materials to learners according to their learning characteristics and content, can provide both instructors and learners with extensive knowledge about how they improve their teaching and learning abilities and can improve communications and interactions between humans and computers by specifying the semantics of the learning style models' characteristics. While a large number of published research studies about Semantic Web and ontologies in learning and pedagogic systems are found in English works, a

comprehensive search in Persian citation indexes including Irandoc, SID, Ensani and Noormags resulted in fewer relevant studies. Therfore, the lack of exhaustive research in the Persian language in the mentioned field shows the necessity for an influential educational model based on semantic technologies and ontologies.

Methodology

The present study was conducted by means of the Soft Systems Methodology (SSM), which is considered one of the operations research techniques that are classified into two types: hard and soft. The soft operational research, unlike the hard one that is only interested in solving problems, structures them. The soft operational research often uses qualitative, rational, objective, and structured methods to more deeply interpret, define, and explore various perspectives in an institution and its own problems (Mehregan and Hosseinzadeh, 2009). This method has resulted in more negotiation, learning, and understanding of phenomena. The obtained perceptions are used for improving the situations and resolving the complex problems. Given that the issues in LIS education are complex with many involved actors and beneficiaries, it seems that soft methodology could achieve better results. Therefore, by employing SSM, a process is presented that can solve some parts of the problems affecting the educational ecosystem of this field. SSM was, for the first time, provided by Peter Checkland et al. from the University of Lancaster. SSM is a method that leads to learning through research on the problem conditions (Connell, 2001). There are various methods that can be used to perform SSM; however, the basis for using them is always the same. Checkland and Poulter (2006) suggest seven steps for the purpose that form the basis of our study. These steps are:

1. Enter the situation considered problematic;
2. Expressing the problem situation through a rich picture;
3. Formulate root definitions of relevant systems;
4. Deriving conceptual models;
5. Compare models with the real world;
6. Defining changes that are both desirable and feasible;
7. Taking action.

The method for performing SSM

In order to explain the problematic situations, the literature on the education of LIS from the beginning of 1991 to the end of 2018 was reviewed. Obtaining relevant documents, the authors searched in specialized databases the keywords shown in Table 2.

Table 2. Keywords searched in specialized databases.

Keywords	Databases
Library Science(s), Library and Information Science (s), LIS	Online Database for National Library of Islamic Republic of Iran (for books)
Education, Learning, Pedagogy, Instruction, Teaching	Iran Doc (for theses)
Teaching-learning, Instructional and training process	Magiran, Noormags, Ensani. ir, SID (for article journals)
Information Science(s), Information Studies	

The search results include 31 articles, 5 theses and 11 books. Then, core and recently updated documents were selected as the main sources (6 articles, 1 thesis and 3 books) to indicate the real scene of LIS education by covering the other resources' main topics. The problematic situations obtained from the core documents were affirmed as the fundamental problems in the field of Iranian LIS education by LIS professionals including seven professors and three PhD students from Tehran, Tarbiat Modares, and Shahed University.

In the second step, by using the general model of education (Gage and Berliner, 1998), an illustration of the educational ecosystem was drawn to present the status quo.

The third step was dedicated to extract root definitions in the literature and recognize the CATWOE components for beneficiaries of the educational system. In the fourth step, a conceptual model was prepared as a corrective model, then five experts in LIS judged it, and the validity of the obtained model was evaluated by the kappa test of agreement. In the fifth step, the conceptual model was compared with real-world situations, and favorable changes were recognized (the sixth step), and in the last step, some necessary recommendations were presented for implementation of the proposed model.

Findings

Step 1. Enter the situation considered problematic

The main objective of this research is to introduce and design a new educational model in the field of LIS in order to overcome major issues affecting education for the science in Iran. The major issues were taken

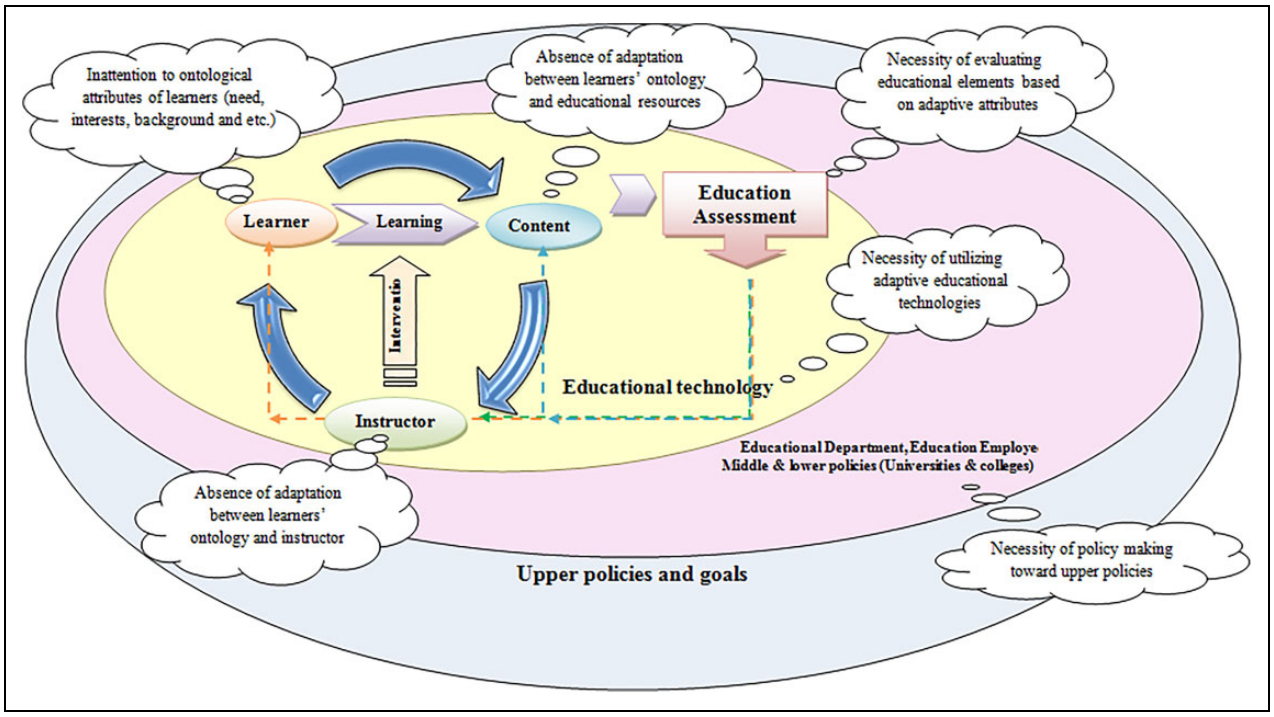

Figure 1. The rich picture illustrating the current situation.

from the specialized and recent literature of the discipline, including:

- the absence of an organic relationship among different educational elements, sovereignty of old-fashioned models and paradigms, lack of cohesive programming and a dynamic educational system (Heidari, 2011);
- the loss of comprehensive and clear picture reflecting topics and sub-topics in this field and a presence of general ambiguity in the internal atmosphere of LIS society (Fadaei et al., 2014);
- the existence of old learning references and resources used by the Information Science departments along with neglecting the (public) services available in the syllabus (Eltemasi and Fahimnia, 2014);
- the lack of attention to designing a systematic framework based on a special philosophy are considered as the main challenge in this domain (Geraei and Heidari, 2016).

Step 2. Expressing the problem situation through a rich picture

In order to present an illustration of the situations and problems existing in LIS education, some credible databases in Persian, including Magiran ،SID ،Noormags and Ensani.ir, were explored. We refined the results of the performed searches based on their relevance to the research problem, and chose the credible literature (scientific-research articles) as the base. Using the general educational model of Gage and Berlinger (1998), the obtained picture was prepared, then judged by five national experts in the LIS field. The result was obtained as an illustration of the status quo, as shown in Figure 1.

Step 3. Formulate root definitions of relevant systems

To help ensure that a draft root definition is acceptable, Checkland developed the CATWOE model where:

C: The Customer. The individual(s) who receive the output from the transformation (The output of the transformation may be negative for some customers and positive for others).

Students (Learners): All students studying LIS (BA, MA or PhD level) in different Iranian universities.

Professors (Instructors): All instructors teaching various syllabuses of LIS in different Iranian universities.

Educational departments: All LIS departments which play a specialized role in the common academic system of Iran.

Colleges: All colleges containing different departments like LIS playing a role at a lower level in the common academic system of Iran.

Universities: All universities containing the abovementioned colleges acting as a middle level in the common academic system of Iran.

Custodian of education: The parent organization of higher education in Iran which acts as the upper level in the common academic system of Iran.

A: The Actors. Those individuals who would do the activities of the transformation if the system were made real.

Students (Learners), Professors (Instructors), Educational departments, Colleges, Universities and Custodian of education.

T: Transformation. The purposeful activity expressed as a transformation of input to output.

The learners enter into the learning cycle and stream by interacting with the educational ecosystem, and acquire the expected capabilities.

W: Weltanschauung. A German word that literally means "world view". It is the belief that makes sense of the root definition.

The enhancement of the educational ecosystem, in a way that the beneficiaries adequately express their satisfaction with the ecosystem, and the quality of the education could be improved.

O: Owner. The wider system decision maker who is concerned with the performance of the system.

Professors (Instructors), Educational departments, Colleges, Universities and Custodian of education.

E: Environmental Constraints. The key constraints outside the system boundary which are significant to the system.

As shown in Table 3, key constraints pertaining to every beneficiary of the system are especially considered. The CATWOE components for beneficiaries are shown in Table 3.

Given the CATWOE components, the root definitions were derived as follows:

Education. It is the process of acquiring or improving knowledge, academic skills (psychology), and attitudes needed for performing an action or a task, through which learners can perform their tasks with a higher performance and effectiveness now and in the future.

Educational technology. It includes a variety of means and tools than are used to improve the quality of learning and the educational process. It is often considered as the communication channel between the three pillars of education, which are learners, educators and the content.

Educational content. It refers to the set of curriculum and related educational resources developed, proposed by the planning committee of the Ministry of Science, Research, and Technology, and it is considered as the basis for the curriculum in educational centers.

Ultimate training objectives. The macro- objectives that indicate the intents and purposes of the educational system of a society. They include objectives related to beliefs, ethics, science, education, culture, art, society, politics, military, economics, biology, etc.

Educational objectives. The educational objectives that are defined according to ultimate objectives of an educational system can be classified into three levels:

1. Major objectives: Objectives that indicate the scope of the considered educational content.
2. Minor objectives: Objectives that are explicit and clear, and which can achieve to a major objective by achieving all of its related minor objectives (they are usually developed in the cognitive scope).
3. Behavioral objectives: Objectives that develop the "behavior" or action, which is expected from learners into a visible or measurable action.

Educational hierarchy

A. Higher education custodian. The institution in charge of policy setting, ultimate objective setting, and explaining the major policy of the higher education area, which is responsible for guiding and supervising the pillars and institutions of this area.

B. Universities and higher education institutions. The intermediate link between the major policy-setting institution in the higher education system and specialized colleges, which is the executor of major objectives, on one level, and the intermediate target setter for its subordinate colleges, on the other level.

C. Colleges. They are centers that execute the education in several scientific-academic fields, and they are responsible for planning, setting minor objectives, and education operation in line with ultimate and intermediate objectives and policies.

D. Educational departments. They are the specialized planner, policy-setter and goal-setter and also the main executor of education in scientific-academic fields, and they play roles within major, intermediate, and minor objectives and policies.

Educators. They are faculty members as well as visiting and contractual educators, who are selected, at the

Table 3. CATWOE components of the educational system.

CATWOE	Component title			
C	Educator	Learner	Educational Department	College
A	Learner, educational content, educational department, college, university, Custodian of education	Educator, educational content, educational department, college, university, Custodian of education	College, university, Custodian of education	University, Custodian of education
T	He/She teaches some of the topics determined by the department and changes them based on its preferences. Moreover, performs the educational assessment of learners.	He/She receives the curriculum from the department, and enrolls in it in order to participate in the provided educational opportunity. Also, performs the sectional assessment of educators.	It is responsible for planning, policy setting, and explaining specialized objectives in line with the educational hierarchy and based on the preferences of educators, time schedules, and topics specified by the planning committee of the Ministry of Science, Research and Technology.	It is responsible for planning, policy setting, and explaining minor educational objectives in line with the educational hierarchy and based on the preferences of the educational group, time schedules, and limitations of the educational space.
W	The educational content and also learners should have the most coordination with preferences and teaching styles of educators, in order to realize the maximum educational quality.	The educational content should have the most consistency with the needs, interests, and learning styles of learners, and should be performed in the shortest period with the highest quality.	Planning, policy setting and explaining the specialized objectives should be fully in line with the educational hierarchy (ultimate objectives) and should lead to the satisfaction of learners, educators and educational groups with them, with the least objections, and provide the highest quality.	Planning, policy setting and explaining the minor objectives should be fully in line with the educational hierarchy (ultimate objectives) and should lead to the satisfaction of educators, learners and superior objectives and finally educational elements
O	Educational Department, College	Educational Department, College	Department	University
E	Despite some spatial limitations, the existing educational facilities and technologies organize their teaching processes. - Sometimes, it is confronted with students with different learning styles, educational needs and preferences. - No comprehensive system of ontological characteristics (the educator ontology) has been envisaged and developed for them.	No comprehensive system has been envisaged and developed for them to assess educational talents, needs, and interests (the learner ontology). The limitations of space and educational technologies can interfere in the learning process of learners. Some topics are provided only by specific educators.	There are some possible resistances to some educational innovations in superior and lower levels. The paradigm governing the field, creates some hurdles for specialized planning. There are some limitations in the compliance of educators' expertise with certain educational topics.	The coordination of budget, educational facilities and space, on one hand, and educational groups, on the other hand, is a complex and difficult process. The probable inconsistence of time horizons in the policy setting hierarchy and in explaining objectives can interfere in the process.

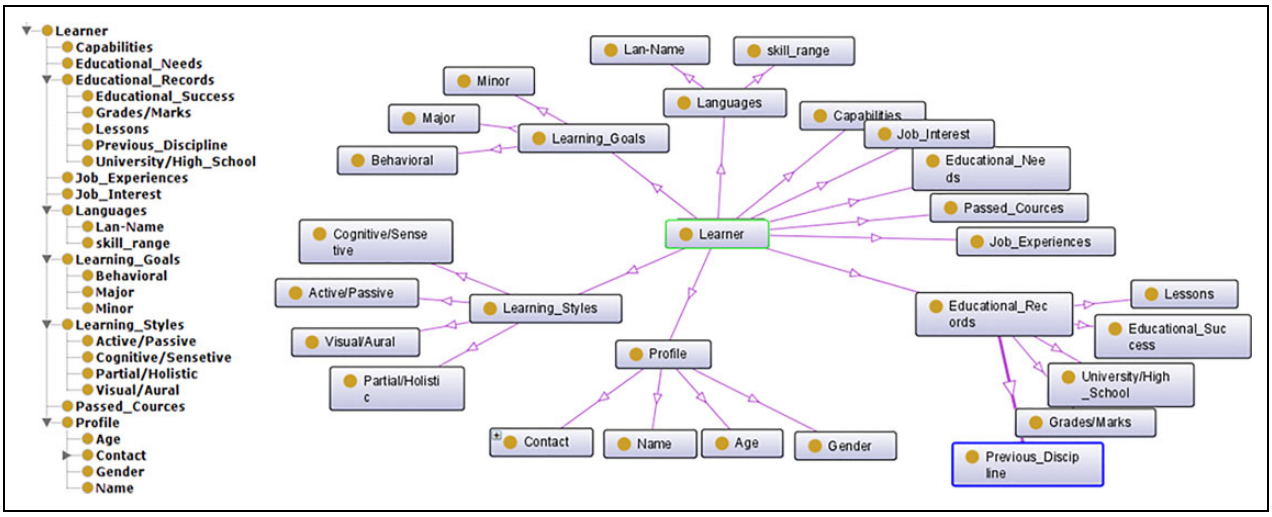

Figure 2. The learner ontology.

discretion of the head of the department, to provide one or more educational topics in different educational levels. Each educator has his/her own ontological characteristics, and the enhancement of the educational quality is expected based on their accordance with the characteristics of learners.

Learners. Students who are studying (whether in the beginning or close to the end) and are considered as the target and key elements in the educational process. Thus, identifying the identities and ontological characteristics of learners as the target of the educational cycle, for every micro or macro educational system, is of particular importance, and their ontology is considered as the most central element in planning.

Ontological components. They are indicators based on features, interests, and fundamental needs of educators and learners that form their professional identity in the learning-educating process, and are displayed in the form of concepts, features, and relationships.

Ontology. It is a set of represented elements that model a knowledge field or an academic field, and utilizes concepts, features, and relationships in order to integrate heterogeneous systems, the interactivity among separate systems, and the semantic representation (Liu and Ozsu, 2008).

Step 4. Deriving conceptual models

At this point, the root definitions are presented in the form of conceptual models, where the focus is on the process of converting inputs into outputs. This model includes actions that ultimately need to be logically linked together (Checkland and Poulter, 2006). Therefore, at first, three conceptual models are presented and the fourth model is presented as the result and the aggregation of the four previous models. Reviewing the recently implemented ontological models, the authors chose the most adaptive ones with the root definitions of Iranian LIS education to be used as the pattern for a proposed alternative model called the conceptual model. Accordingly, in this step, the beneficial ontological models implemented by experts in the real environment were distinguished as the best choice to improve the current conditions of LIS education in Iran.

A. The conceptual model based on the learner ontology. This model is designed and suggested based on the learner (or student) ontology, adapted from the smart learning environment model of Oufa et al. (2017). The researcher has implemented the learner ontology using the software Protégé 4.3 and the language OWL 2.0 based on the mentioned model (Figure 2).

The systematic searches made by the researcher in articles indexed in databases of (Elsevier, Science Direct, Eric, IEEE), showed that the model of Oufa et al. (2017) is considered as one of the most comprehensive models proposed for the learner ontology system. Thus, the implemented ontology was used as the basis for introducing the first conceptual model (Figure 3).

B. The conceptual model based on the educator ontology. This model is designed and suggested based on the educator (or teacher) ontology, adapted from the semantic framework of Miranda et al. (2016). The software Protégé 4.3 and the language OWL 2.0 was used as the basis for implementing the mentioned model (Figure 4).

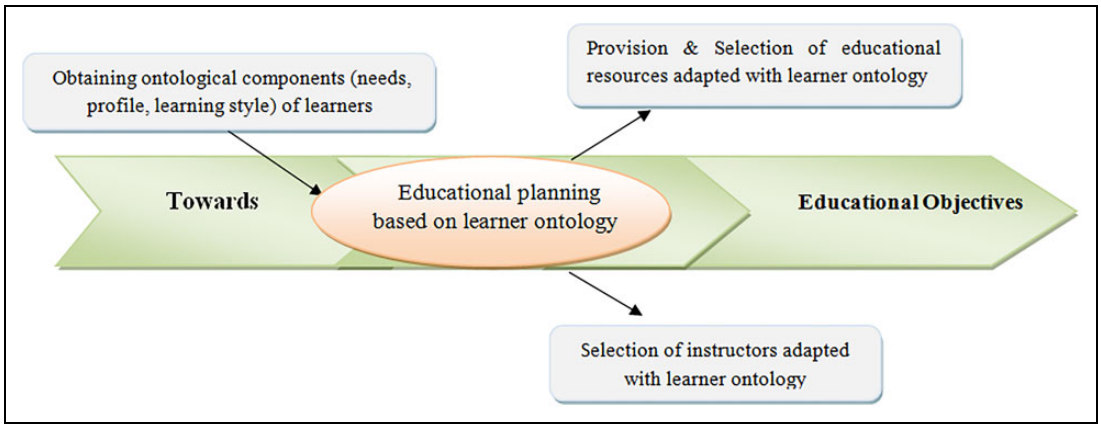

Figure 3. The conceptual model based on the learner ontology.

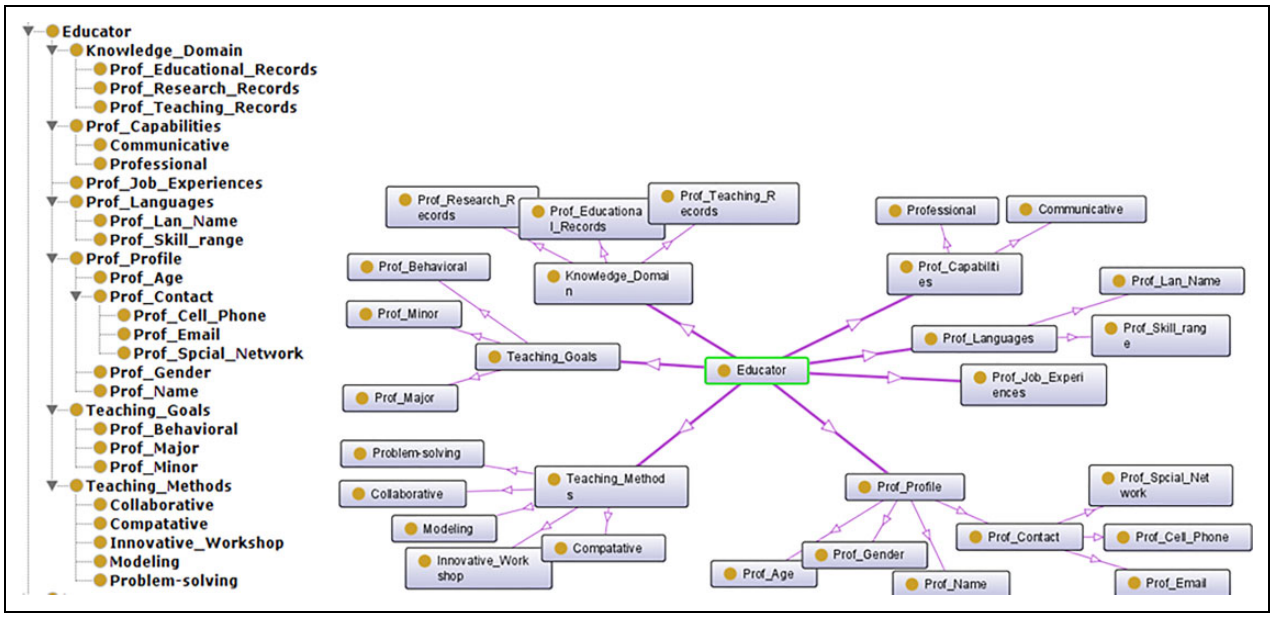

Figure 4. The educator (professor) ontology.

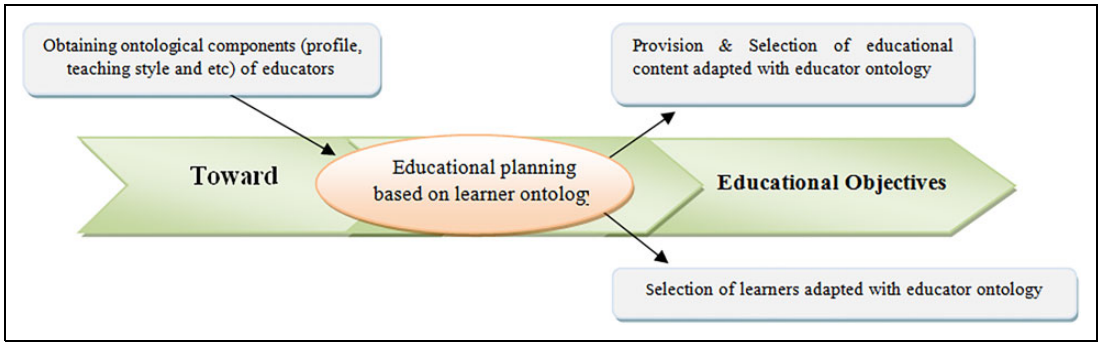

Figure 5. The conceptual model based on the educator ontology.

The systematic searches made by the researcher in articles indexed in databases of (Elsevier, Science Direct, Eric, IEEE), showed that the model of Miranda et al. (2016) is considered as one of the most comprehensive models proposed for the educator ontology system. Thus, the implemented ontology was used as the basis for introducing the second conceptual model (Figure 5).

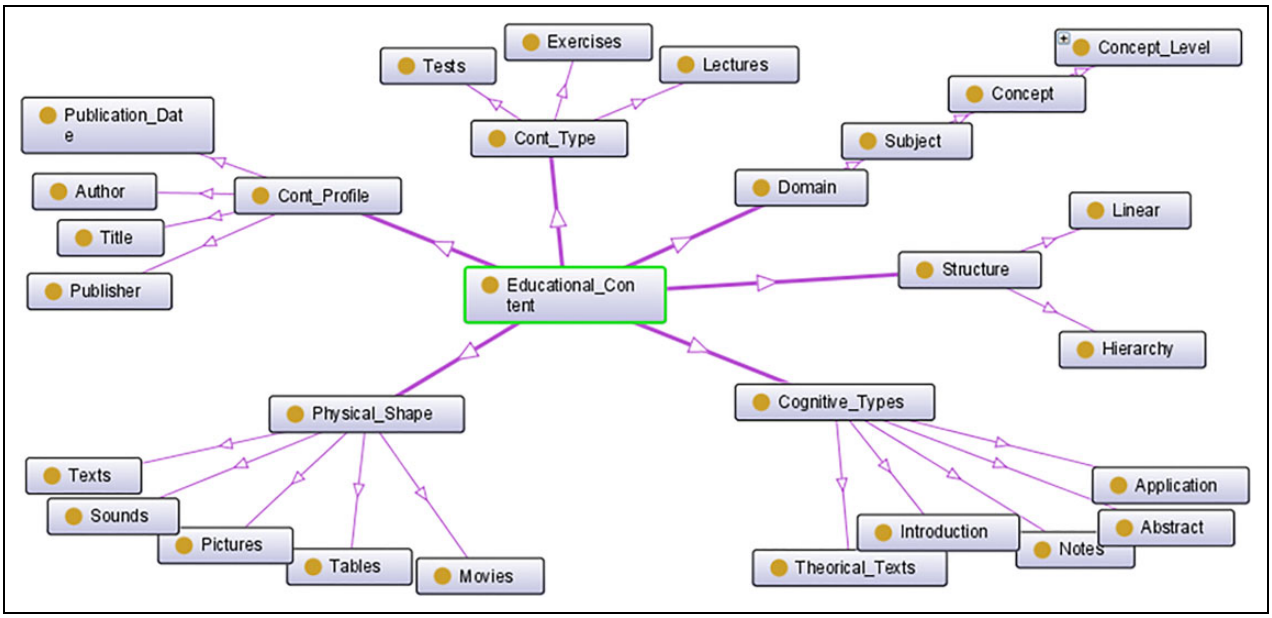

Figure 6. The educational content ontology.

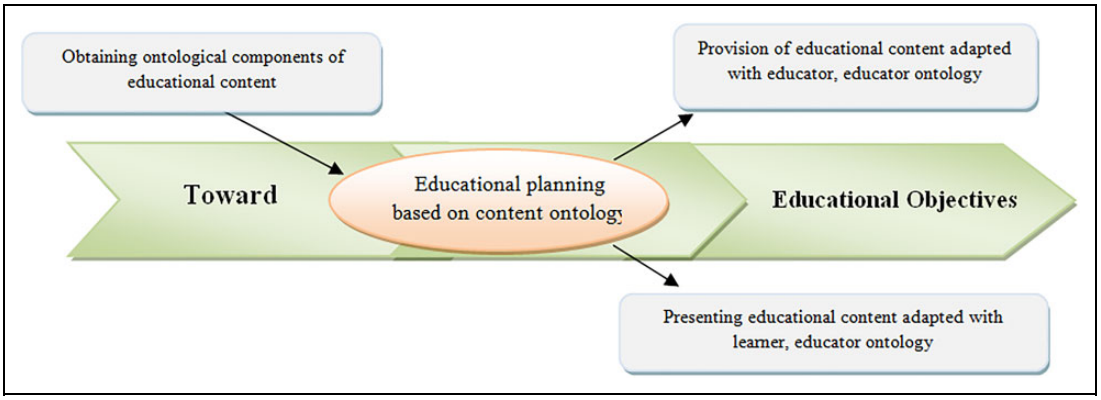

Figure 7. The conceptual model based on the content ontology.

C. The conceptual model based on the content ontology. This model is designed and suggested based on the content ontology, adapted from the ontological model of educational content done by Poulakakis et al. (2017). The mentioned model was implemented by using the software Protégé 4.3 and the language OWL 2.0 (Figure 6).

The systematic searches made by the researcher in original articles indexed in databases (Elsevier, Science Direct, Eric, IEEE), showed that the semantic framework of Poulakakis et al. (2017) is considered as one of the most comprehensive models proposed for the content ontology system. Thus, the implemented ontology was used as the basis for introducing the second conceptual model (Figure 7).

D. The conceptual model based on the meta-ontology of education. This model was explained based on the meta-ontology of education, obtained by mapping the domain ontologies (learner, educator and content) in the framework proposed by Luna et al. (2015) (Figure 8).

Similar to the previous steps, the software Protégé 4.3 and the language OWL 2.0 was used as the basis of the meta-ontology of education (Figure 9).

Thus, the implemented ontology was used as the basis for introducing the accumulative conceptual model (Figure 10).

Obviously, the obtained model has a relative validity, because it is based on the previous studies and is accurate in examining the content of the references. However, in order to ensure the accuracy of the components of the obtained model, and bring it close to the scientific and fundamental perspective, we concluded that we should validate it separately. In the present study, in order to validate the model, a survey from five experts in the field of LIS education in Iran was conducted using the kappa method. In the

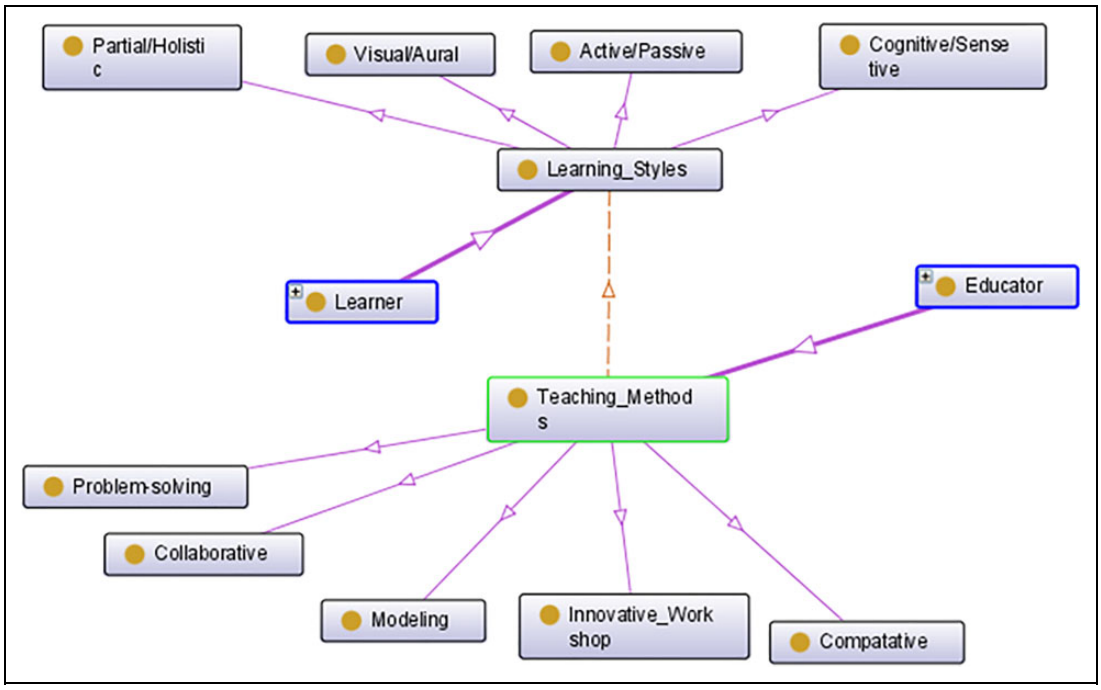

Figure 8. The typical mapping of ontologies.

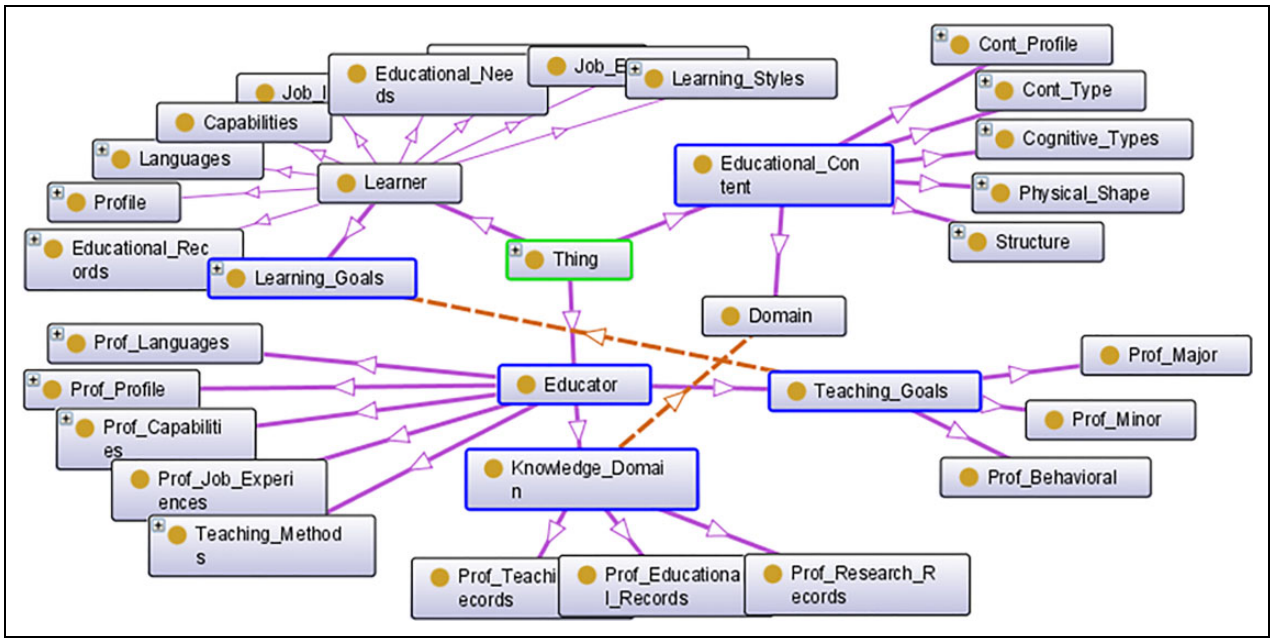

Figure 9. The meta-ontology of LIS education.

following, the results of calculating the kappa agreement coefficient related to this process were evaluated and presented. In this method, using the kappa statistical test in the software SPSS 20.0 and calculating the kappa coefficient, the extent of the agreement was obtained.

Based on the data presented in Table 4, the measurement of the achieved agreement regarding the components of the research model was calculated over 0.92 with the standard error of 0.035 and the Sig of 000. Thus, the validity of the research model was confirmed with the great measurement of the significant agreement (higher than 0.8).

Step 5. Compare models with the real world

Due to the subjectivity of the conceptual model, it should be compared with real-word situations, in order to identify the changes needed to improve the current situation. To compare the optimal situation

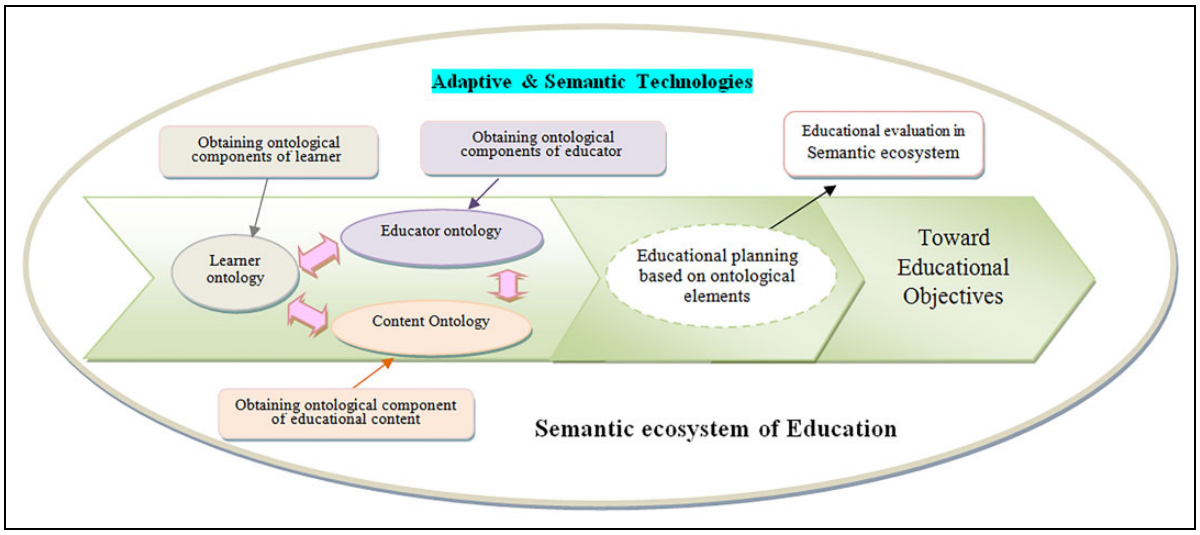

Figure 10. The accumulative conceptual model (The final model).

Table 4. Results of the kappa probabilistic test.

Items				The calculated alignment		
Valid		Missing				
Count	Percent	Count	Percent	Measurement of agreement	standard error	Sig
78	100	0	0	0.926	0.035	000

(the conceptual model) with the process that is currently happening in the education field, in this stage workflow diagrams were used. See Table 5.

Step 6. Defining changes that are both desirable and feasible

This step includes the systematic determination of the appropriate changes, which are also possible culturally. Both the desirability and the feasibility were taken into account in adjusting the changes, which are as follows:

1. Acquiring the motivation and the idea of changes, and optimizing the educational system of the field;
2. Establishing coordination among the stakeholders in the field of education;
3. Providing forms, questionnaires and tests to learners in the early stages of entrance into the educational cycle (determination of ontological features of learners);
4. Determination of the ontological features of educators with questionnaires, interviews and surveys;
5. Monitoring the ontological features of the educational content;
6. Providing Semantic Web technologies;
7. Designing the semantic model of education in the zero phase;
8. Implementing and executing the semantic educational model;
9. Evaluation and receiving the feedbacks.

Step 7. Taking action

Based on the nine mentioned steps, the changes needed to improve the educational system for LIS were explained. However, according to the fundamental nature of the reforms, the usage of, and benefits from, its results will be visible and measurable in the long term. In this regard, the final model was suggested to the Educational Department of Library and Information Science in the University of Tehran as the optimal model, and it received a warm welcome. Since the SSM is considered as a soft operations research method, the principles and assumptions governing it are also true in this regard. The uniqueness of the designed model is a feature of this method. Therefore, the results of the model are somewhat limited to the institution under study, and generalization of it to similar organizations requires local situations and the agreement of the organizational beneficiaries.

Table 5. Comparison of the conceptual model with the real-world situation.

The educational cycle	The current situation	The proposed model
The manner in which the learners enter into the field	Learners enter into fields based on their levels and ranks in the national entrance examination.	Based on the nature of the field, the group and the department, the primary criteria for the entrance of learners are announced to the National Organization for Educational Testing.
The beginning of the entrance of learners in the educational process	The educational certificates and the identity documents of learners are received, and they understand the criteria and programs.	In addition to the initial acceptance, the educational needs, interests, experiences, learning styles, etc. of learners are developed in the form of tests or specialized interviews and the learner ontology
Development of the curriculum for each discipline	The planning committee of the Ministry of Science, Research and Technology, consisting of the outstanding educators of each field, is responsible for developing the curriculum every 5 years.	By preparing the map of the learner, educator and content ontologies, we can help the committee in adopting best educational topics.
Determination of educators of topic	Based on the timing blocks of educators, the determined curriculum and the class limitation, the educators of each course are determined.	Research preferences, teaching experiences, teaching styles, etc. of educators are determined, the curriculum is adapted with the educator ontology and potential educators are determined.
Selection of the educational content	Mainly, the educators of each topic choose the educational content based on their preferences and the references proposed by the planning committee of the Ministry of Science, Research and Technology.	The ontological features of the existing educational content are determined, and the selection is performed based on the learner ontology and the educator ontology, and the hierarchy of educational objectives.
Choosing the provided courses and their respective educators by the learner	Usually, it is done without an adequate understanding of the educators.	Learners, by knowing the educator ontology, will be able to consciously select educators and the corresponding courses.
Education technologies	It is done based on the common and adaptive methods.	It is done using the Semantic Web technologies (ontologies) that are adaptive between educational elements.
Educational assessment of learner	Generally, it is done based on the preferences of educators.	By obtaining the learner and content ontologies along with adaptive educational technologies, the quality assessment would be possible.
Assessment of the educational system	Often, it is not done in a systematic way, and the systematic monitoring of deviations of the educational process from the objectives is not possible.	Semantic Web technologies would enable the educational system to realize the systematic monitoring of itself in an updated manner.

Discussion and conclusions

Undoubtedly, the issues of the field of education are multi-faceted, complex and interdisciplinary. Therefore, providing a model that can be a comprehensive solution for the existing challenges and difficulties seems significantly simplistic. Taking into account the point and applying the SSM method, the present study attempts to explain the issues governing LIS education based on the specialized literature of this field, and it seeks to resolve some of the mentioned hurdles by presenting a corrective model derived from updated educational experiences and by validating it using experts' opinions. The kind of issues affecting the education of this field in recent literature (including Eltemasi and Fahimnia, 2014; Fadaei et al., 2014; Geraei and Heidari, 2016; Heidari, 2011) which have been authored from a pathologic viewpoint, implies the necessity of a fundamental change in the approach

to the field. Thus, the integration of issues of organization, representation and knowledge management with new issues of education and training, the transition from the current model to a model based on a new paradigm that affects various aspects of the educational process, from educational technologies to learners and educators, and realizes the adaptability of the elements involved in the educational system, made the education accessible in a semantic model.

The literature showed that attention to the importance of the semantic model in different generations of the educational system has not only decreased after one decade of its prevalence, but we see an increase in original studies and also the more extensive interest of researchers in this field. Ontologies and semantic technologies will play the key role in the future of learning environments by realizing the adaptive system of education and creating semantic relationships (Torre, 2009). The fact that there is only one work on this model in LIS (Fernandez-Breis et al., 2009) and the necessity of more attention to the semantic models of education on the part of the experts of this field, makes this research one of the first research works to model this generation in the educational system of Iran, at the macro level, and in LIS, at the micro level. In this regard, in order to overcome the issues of the field of education in LIS in Iran, which have been mentioned in recent literature, we carefully studied the usage of the semantic model of education, which is designed based on the Semantic Web and ontologies, based on the studies conducted on efficient educational models in other educational systems. As Trilling and Fadel (2009) see certain and inevitable the need to change the approach, from the previous model of learning to the new paradigm of learning based on learner participation and benefiting from new information and communication technologies, especially the Semantic Web, in order to achieve lifelong learning, this paradigm shift can be an effective response to the issue that the educational system of Iran, even at the highest levels of education, is based on traditional and old paradigms of education (Heidari, 2011). Although Heidari considers the lack of an organic connection between different levels of education and the lack of a coherent planning and a dynamic educational system as other characteristics of the current educational system in information science in Iran (p. 17), Kravcik and Gasevic (2010) consider the coordination and the establishment of an organic connection between various aspects and elements of the educational system as advantages of the ontology-based system. In addition, Miranda et al. (2016) consider the representation of the main concepts and issues and sub-issues related to the educational content and the delivering of educational objectives, attitudes, skills, knowledge, experiences and learning activities as the key roles of the semantic educational system. Therefore, the semantic system can beneficially solve the lack of a clear picture of scientific activities, issues and sub-issues of the field, and the ambiguity in the internal space of the community of library and information science mentioned by Fadaei et al. (2014) as the fundamental problems.

And in response to the pathology of Geraei and Heidari (2016), which considers the lack of sufficient attention to the design and development of a systematic framework based on a specific philosophy for the education of this field in Iran as the other shortcomings, the findings of Johnson (2016) regarding the function of the ontological system, suggesting the providing of a systematic framework from educational system capacities and the emphasis of many educational theories on representation of the formal knowledge of this field using Semantic Web technologies (Sicilia et al., 2011), more than before confirms the strategy of the semantic system of education to resolve the existing hurdles in the field of LIS. It should be explained that the entrance of the semantic system of education into the field of LIS has additional advantages that will benefit the existing academic system of education beyond resolving the existing problems. For example, benefiting from the ontology enables the establishment of a semantic connection between various components of the learning ecosystem, including the characteristics and the learning styles of learners, the teaching methods and techniques, and the educational content and resources, and through them, facilitates the effective learning and improves the quality of learning (Oufa et al., 2017). Moreover, providing multilevel learning, coordinating various aspects of the adaptive educational system, increasing the interoperability of different and inhomogeneous systems, automatic processing of knowledge, establishing a relationship between various personalized knowledge, realizing adaptable learning processes, extracting semantic knowledge from unstructured texts, and creating Semantic Web standards are among other features of semantic models in academic education (Warren, 2006). The systematic control of elements in the proposed model means that the adaptation of main concepts with each other through the corresponding components and subcomponents is measured in both intelligent and semi-intelligent manners (Kravcik and Gasevic, 2010), and by changing each sector, the necessary changes are taking place in other sectors. Thus, the automatic and semi-automatic updating is another advantage of this model, and the inadaptive and

non-updated element is identified as disruptive to the system and is corrected. Therefore, the curriculum and educational content that are inconsistent with educational objectives, the learners' needs and the professional environment (Eltemasi and Fahimnia, 2014) are replaced with the most appropriate content and resources, and at the same time, the existing gaps in the educational content are identified.

Regarding the mentioned points, the obtained model is not only capable of being used in a specific field of knowledge and educational system but is also capable of being used and localized in various organizations, institutions, and fields that are related to learning and education. This is why Wang et al. (2014) argue that future generations of educational systems and sub-systems will be the same as educational frameworks based on the Semantic Web and smart frameworks. Given the importance of the issue of the semantic system and Semantic Web technologies in education, we can consider the present study as a pioneering work (at least in Persian) and use its results in the related fields. As the research findings indicate, the applied studies to normalize and standardize the mentioned model and also to create an effective tool for analyzing the educational process can be a future research subject for researchers in this field. Given the high efficiency of SSM in dealing with real-world complex problems, compared to hard operations research methodologies, the method used in this research is suggested for the education of other groups and departments of the University of Tehran.

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