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ONTOLOGY-BASED GENERATION OF MULTILINGUAL QUESTIONS FOR ASSESSMENT IN MEDICAL EDUCATION

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Abstract. *The requirements of state-of-the-art curricula and teaching processes in medical education have brought both new and improved the existing assessment methods. Recently, several promising methods have emerged, among them the Comprehensive Integrative Puzzle (CIP), which shows great potential. However, the construction of such questions requires high efforts of a team of experts and is time-consuming. Furthermore, despite the fact that English language is accepted as an international language, for educational purposes there is also a need for representing data and knowledge in native language. In this paper, we present an approach for automatic generation of CIP assessment questions based on using ontologies for knowledge representation. In this way, it is possible to provide multilingual support in the teaching and learning process because the same ontological concept can be applied to corresponding language expressions in different languages. The proposed approach shows promising results indicated by dramatic speeding up of construction of CIP questions compared to manual methods. The presented results represent a strong indication that adoption of ontologies for knowledge representation may enable scalability in multilingual domain-specific education regardless of the language used. High level of automation in the assessment process proven on the CIP method in medical education as one of the most challenging domains, promises high potential for new innovative teaching methodologies in other educational domains as well.*

Key words: *medical education, assessment, multilingual teaching, ontology, artificial intelligence, comprehensive integrative puzzle*

1. INTRODUCTION

The main purpose of medical education (ME) is to train workforce to provide and improve patient treatment (Teodorczuk et al., 2017). In order to provide appropriate treatment medical physicians need to determine the correct diagnosis of the disease (Romero-Tris, Riaño & Real, 2011). The ability to communicate effectively with patients is a basic clinical skill that is essential for setting up right diagnosis and thus conducting all necessary treatments (Wette & Hawken (2016). Besides developing communication skills in their native language, medical students face the challenge of mastering English language as well, since it has become lingua franca of medical international communication.

In the context of newly advanced curricula and teaching processes, ME institutions are under high pressure to develop new and improve the existing assessment methods. Faculty

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observation, oral examinations, and multiple-choice tests have traditionally been used as assessment methods in ME (Howley, 2004). Recently, promising new methods have emerged and of these, the Comprehensive Integrative Puzzle (CIP) shows great potential (Ber, 2003). This has been applied in various fields of medicine, and studies have shown positive attitudes towards it among students (Ber, 2003). It also has a strong discriminatory quality, due to the possibility of score differentiation (Van Bruggen et al., 2012). However, in the same way as for other assessment methods, the major obstacle to addressing higher cognitive skills lies in the construction of CIP. In order to reach its full potential, questions must be authored by highly skilled professionals. Such professionals are scarce for a number of reasons, including the difficulty of securing the right person for the job, the high costs of engaging specialists, and various organizational and management barriers. Accordingly, there is a strong need for the automatic generation of this type of assessment, as it will significantly reduce the workload of teachers.

One possible solution for CIP automatic generation is application of artificial intelligence (AI) that represents the ability of a machine to copy human intelligence processes, learn from experiences, adapt to new information and perform human-like activities. The main advantage of AI is precisely the automation of complicated and time-consuming tasks (Karsenti, 2019). For knowledge representation, we propose ontologies as a part of AI to achieve automatic generation of CIP assessment method. Ontology is defined in different areas of philosofy and science in somewhat different ways. The origine of the term lies in philosophy and relates to describing the world as seen by a group of people at certain time according to a school of thought that is based on a view of the world (El-Diraby &Osman). In informatic systems, an ontology is the means to formally model the structure of a system (Guarino 2009). Formal foundations of ontologies make them effective in using encoded knowledge in software development, such as in semantic (Shadbolt, Berners-Lee, & Hall, 2006) and big data technologies (Pop, Kołodziej, & Martino, 2016). Furthermore, their formal foundations allow for advanced domain modeling and algorithm development even in the most challenging applications in which sophisticated human expert reasoning has traditionally been the only choice.

Although English language is accepted as international language for publishing and research, in many applications and areas, there is a need for representing data and knowledge in native language as it enables content reuse and extends its usage to traditionally wider audience making it more effective (Ivanova, 2019). There are many approaches that rely on usage of ontologies and semantic web to improve learning and assessment but most of the developed ontologies target only English language. However, usage of multilingual ontologies for resource annotation could enable more efficient interlingual content delivery, as well as its reuse in e-learning systems, making the learning content itself adaptable for a much wider audience (Ivanova, 2019-2). In this paper, the multilingual ontologies based automatic generation of assessment in medical education is considered and evaluated in CIP case study.

The rest of this paper is structured into 7 sections. In Section 2, background and related work provide an overview of concepts and technologies used to propose our approach, such as medical education and the English for Medical Purposes ontologies, mapping between relational database and ontologies, multilingual mapping, etc. In Section 3, the problem of automated generation of CIP assessment method is defined. In Section 4, the OntoCIP ontology which semantically presents CIP assessment method is described. Section 5 covers the process of determining candidate answer in question generation. In section 6

architecture and implementation overview of the proposed approach for automated question generation is explained. Evaluation and results are given in Section 7. Finally, Section 8 covers conclusion and future work.

2. Background and Related Work

2.1. English for Medical Purposes education

Proficient knowledge of English is fundamental for medical students, especially for those wishing to acquire and develop their skills by following the changes and developments in their field (Çelik, 2017). Although medical education institutions in many countries where English in not official language (Bakić-Mirić, 2013) (Yurchuk et. all, 2015) (Çelik, 2017) have adopted it as a medium of instruction, it has been noticed that students in such environmentss are most likely facing problems in dealing with their medical subjects. Consequently, designing appropriate courses to assist students in coping with the language challenges is becoming ever more relevant (Faraj 2015).

Since internationalization of higher education has been increasing, many medical students now study in English speaking institutions. Conducted researches (Hoekje, 2007) (Dahm, 2011) (Wette & Hawken, 2016) shown that language, communication and cultural issues can still persist for foreign students during and after their education and residency training. Accordingly, English speaking counties seek to develop ESP courses that will meet the needs of foreign students and residents regarding acculturation, the language and culture of the patient community, the language of the hospital, and intelligibility in performing key medical texts (Hoekje, 2007).

2.2. Assessment in medical education

Although medical education and training varies considerably across the world (Flores-Mateo & Argimon, 2007) one thing that is common for all countries and regions, is assessment, which is necessary at all stages of a medical student's education. From the moment they enroll into medical school and during all phases of medical education and practice, medical students and physicians are constantly being assessed for multiple purposes.

The use of a variety of different assessment methods has been characteristic of every field of education, and medical education is no exception. Since 1950s, the medical knowledge and clinical skills of students and doctors were often assessed using oral and written examinations. With the advent of new technologies, the way assessment is conducted in medical education changed rapidly. New methods, such as clinical simulations or multisource assessment, have focused on clinical skills (taking history from a patient and performing a physical examination), communication skills, procedural skills, and professionalism (Norcini & MyKinley, 2007).

2.2.1. The Comprehensive Integrative Puzzle Assessment Method

The preparation of a CIP is work that needs a team of experienced teachers or experts in different fields of medicine: clinician, pathologist, microbiologist, pharmacologist, biochemist, radiologist, etc. Each team determines clinical scenarios and prepares a pool of relevant material, such as ECG and EEG strips or interpretations, X-ray, CT, MRI or their interpretations, pathology pictures and/or slides or their descriptions and endoscopy

photographs or descriptions (Ber, 2003). Considering all these facts, it can be noticed that preparation of CIP is a time-consuming task even for an experienced teacher. According to Van Bruggen, preparation of one CIP question requires 1 to 2 hours for an experienced teacher (Van Bruggen et al., 2012). The CIP assessment takes the format of an extended matching crossword puzzle with an appropriate pool of options (Figure 1). The CIP answer sheet takes the form of a puzzle grid composed of between four and seven rows and columns (Ber, 2003). The left-hand column contains possible diagnoses or brief clinical vignettes, while the rest of the columns contain information about patient's story (medical history), physical exam, chest X-ray and electrocardiogram, laboratory, pathology and treatment. Beneath the puzzle grid, several parts marked Sections I, Section II, etc., correspond to the columns in the grid. Each section contains several options indicated by letters (for example a–f). In order to complete the puzzle, students choose one option from each section and place it in the cell in the appropriate column.

Matching columns						
Diagnosis	I: Medical history	II: Physical examination	III: Chest X-ray and ECG	IV: Laboratory and other tests	V: Treatment and follow-up	VI: Pathology
Chronic Obstructive Pulmonary Disease	B	F	B	B	A	C
Hemorrhagic Stroke	C	C	D	F	E	A
Type 1 Diabetes	D	B	E	C	B	E
Acute Renal Failure	E	D	C	D	C	F
Type 2 Diabetes	A	E	F	E	F	B
Myocardial Infarction	F	A	A	A	D	D

Section I: Patient's presenting stories
(a) Patient complains of recurrent moderate tingling of the feet over the past month. The pt reports moderate weak urinary stream, moderate foamy urine. Patient is a 57-year m. Patient is a heavy smoker of cigarettes. Patient reports that he never drinks alcohol.
(b) pt c/o 3 weeks h/o critical cough (not checked), critical dyspnea, critical shortness of breath. NKDA. Patient is a female landlord aged 34 yrs.
...
(d) Patient presents with 3 years history of severe weight loss. Pt also reports increased frequency of severe frequent urination, severe increased thirst. Patient is a 35 yr old female receptionist.
...
Section IV: Laboratory and other tests
(a) Transthoracic echocardiography: shows Ventricular Septal Rupture
(b) FEV1=35 %
(c) HCO3=17 meq/L
...
Section V: Treatment and follow-up
(a) OMS 50, via nasal cannula (contin)
(b) Potassium Chl po qd
(c) AVAPRO, by mouth daily
(d) nitroglycerine 2xday
(e) mannitol IV
(f) glyburide daily
...

Figure 1 CIP answer sheet, generated from the used data source

It should be noted that CIP allows for adjustments to different degrees of difficulty. For example, at the lowest level of difficulty, each option may be used only once; that is, one description of a medical history (or physical, treatment, etc.) can be assigned to only one diagnosis. CIPs at higher degrees of difficulty may offer more than six sections (columns), more than six options/distracters per section, and may include instructions that 'each option may be used once, more than once, or not at all' (Ber, 2003). In addition, not all columns need to be displayed. If a diagnosis does not need a chest X-ray or ECG, the teacher can choose not to display this column in the assessment.

2.3. Ontologies

Over the years, ontologies have matured into a cornerstone technology in conjunction with semantic web services and the semantic grid (Gladun, Rogushina, García-Sanchez, Martínez-Béjar, & Fernández-Breis, 2009). Advances in the semantic web (Tim, Lee, Hendler, & Lassila, 2001) and linked data (Bizer, Heath, & Berners-Lee, 2009) have facilitated the emergence of a new trend in question generation that is based on the use of ontologies. The adoption of ontologies is particularly promising when scalability is required, either due to the massive amounts of data used or the large number of users involved, and when the task at hand requires an expert level of knowledge that is specific to the target application domain. In the literature, various approaches involving the successful application of ontologies in the generation of assessment methods can be found (Cubric & Tosic, 2011)(Jelenkovic & Tosic, 2013)(Vinu & Kumar, 2015)(Vinu, Alsubait, & Kumar, 2016)(Radovic et al., 2017)(Radovic et al., 2018). Ontologies can be grouped into four types: (i) top-level ontologies describing the most general concepts (space, time, emotions, etc.) that are independent of a particular problem or domain; (2) domain ontologies; and (3) task ontologies describing generic tasks or activities in general domains (medicine, cars, biology) such as diagnosing (for medicine) and selling (for cars); these types of ontologies refine the concepts introduced in the top-level ontology; (4) application ontologies that describe concepts depending on a particular domain and task. For the purpose of automated assessment methods task ontologies should be applied.

2.3.1. Multilingual Approach in Ontologies

Multilingual ontology mapping is defined as a type of ontology mapping where the matcher is capable of dealing with ontologies expressed (or labelled) in multiple languages. Multilingual ontology mapping requires modifications of some of the existing mapping algorithms in order to make them work in a multilingual environment. However, most of the approaches to multilingual ontology mapping rely on general-purpose machine translation services (Ivanova, 2019) (Ivanova, 2019-2). Furthermore, multilingual labels are supported using the language tagging facility of RDF literals, which makes RDF suitable for development of multilingual semantic knowledge bases. In the existing literature, several solutions have been proposed. In (Alatrish, E. S. et al., 2014), various software tools available on the Internet were used (most notably DODDLE-OWL, WordNet, Protégé and XSLT transformations) to implement a procedure to construct domain ontology for any natural language. On the other side, in (Ivanova, 2019), a framework leveraging a set of domain ontologies for representation of pedagogical knowledge was introduced. In that paper, Bilingual Linguistic Domain Ontology (BLDO) was used to presents the structure of the course knowledge (or learning content) using labels in both Bulgarian and English.

Moreover, in (Trojahn et al., 2008), there is presented a framework for automatic mapping of multilingual Description Logics (DL) ontologies. Their focus was on the process of translating ontologies, where the source ontology is translated to the target ontology language, using an appropriate dictionary by translation agent, where translation agent refers to a software service, component or platform which performs the translation of given input text originally written in one language to some other target language.

3. THE ONTOCIP ONTOLOGY

For our case related to assessment in medical sciences based on Comprehensive Integrative Puzzle Assessment method, we rely on our OntoCIP ontology (Radovic et al., 2018). In Figure 2, the main classes and properties of OntoCIP ontology are shown.

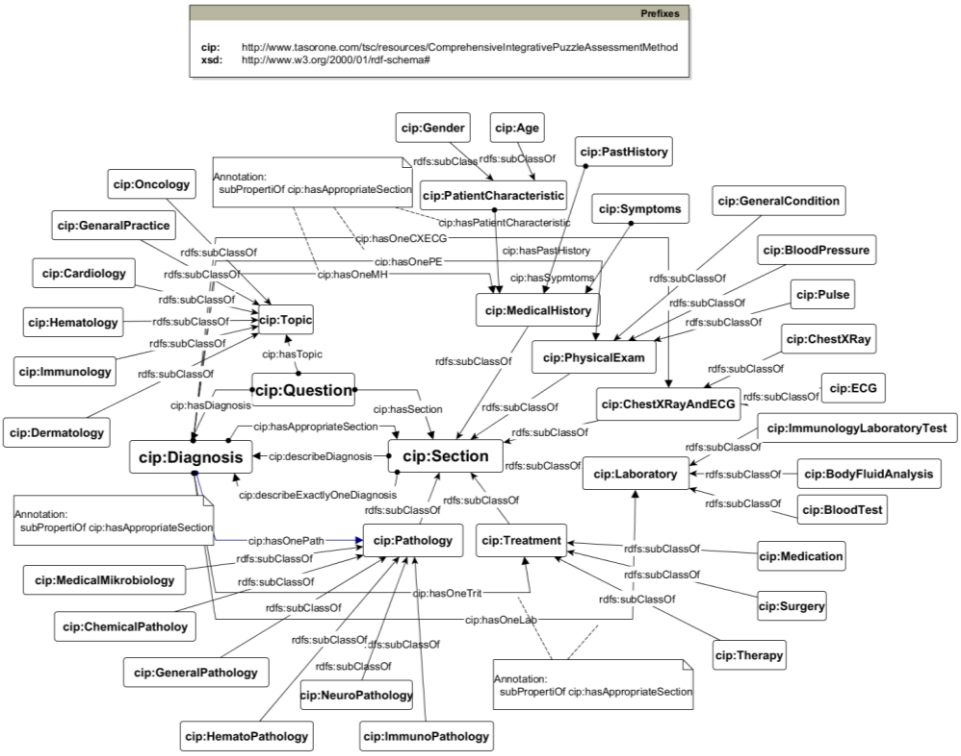


Fig. 2 Main concepts in the OntoCIP ontology

The main classes in OntoCIP are cip:Diagnosis, cip:Section and cip:Question. Diagnosis is defined in medical terminology as the identification of a disease or condition through evaluation and examination[1]. It is the process of determining which disease or condition

[1] https://tinyurl.com/82v7u5d

explains person's symptoms and signs. It can also be presented as a short patient vignette. Each individual instance of the cip:Question class has a containment relation with several (between four and seven) instances of the cip:Diagnosis class and several (between four and seven) instances of the cip:Section class. In other words, each question consists of several diagnoses and sections. This is modeled using the properties cip:hasDiagnosis and cip: hasSection.

The cip:Section class is specialised into the cip:MedicalHistory, cip:PhysicalExam, cip:ChestXRayAndECG, cip:Laboratory, cip:Treatment and cip:Pathology subclasses. Regardless of the level of difficulty, each instance of the cip:Diagnosis class has a containment relation with exactly one instance of the subclasses cip:MedicalHistory, cip:PhysicalExam, cip:ChestXRayAndECG, cip:Laboratory, cip:Treatment and cip:Pathology. This is modelled using the properties cip:hasOneMH, cip:hasOnePE, cip:hasOneCXRECG, cip:hasOneTrit, cip:hasOnePath and cip:hasOneLab. All of these properties are subproperties of the cip:hasAppropriateSection property. Looking at this from the opposite direction, if the lowest difficulty level of the CIP assessment is targeted, then cip:Section will have instances that have a relationship with exactly one appropriate instance of the cip:Diagnosis. In this case, the property cip:describeExactlyOneDiagnosis is used for implementation.

The cip:MedicalHistory has a relationship with the classes cip:Gender, cip:Age, cip:Symptoms and cip:PastHistory. This is modelled due to the fact that the patient's generalities, symptoms or patient subject feelings with a past history of illness are important in order for a physician to establish a diagnosis. The cip:PhysicalExam class contains the subclasses cip:GeneralCondition, cip:BloodPreasure and cip:Pulse. These subclasses represent the main actions that physician carries out during an initial patient exam. The cip:ChestXRayAndECG class is further divided into the cip:ChestXRay and cip:ECG classes. These represent ECG strips and X-ray films, or their interpretation, respectively. The cip:Laboratory represents laboratory tests and is further specialised into cip:ImmunologyLaboratoryTest, cip:BodyFluidAnalysis, cip:BloodTest. Depending on the patient's symptoms, the physician will order certain laboratory tests. The cip:Treatment class is divided into several subclasses: cip:Medication, cip:Surgery and cip:Therapy. Each of these is further specialised into several subclasses. The cip:Pathology class is also divided into several subclasses such as cip:ImmunoPathology, cip:NeuroPathology, etc.

4. Candidate Answer Generation

Based on the difficulty level, the cip:Section class may have instances that have a relationship with one or more instances of the cip:Diagnosis class. This is implemented using the property cip:describeDiagnosis. The cip:Section class can also have instances that have no relationship with instances of the cip:Diagnosis class that represents the distractors in the question. In order to generate distractors, a semantic similarity strategy was used. Semantic similarity can be defined in several different ways, but for the purposes of this paper, we define it as a function of the distance between the concepts in a graph corresponding to the hierarchical structure of the underlying ontology (Gan, Dou, & Jiang, 2013). The distance between two concepts (Lee, Shah, Sundlass, & Musen, 2008) is a numerical representation of how far apart two concepts are from one another in some geometric space. It can be considered the inverse of semantic similarity. Figure 3

gives an example of this distance in the classification (diagnosis) of chronic diseases. The dashed line indicates the large distance between *Chronic ischemic colitis* and *Intermittent exotropia of the right eye*; these are not very similar, and putting them in the same question will produce an easy choice for students. On the other hand, *Chronic ischemic colitis* and *Chronic bronchiolitis* have a short distance (marked with a dashed/dotted line), and are very similar (they are both in the same level in the hierarchy); hence, putting them into a given question would require a higher level of knowledge of diagnosis and appropriate medical history, treatment, etc. to give the right answer.

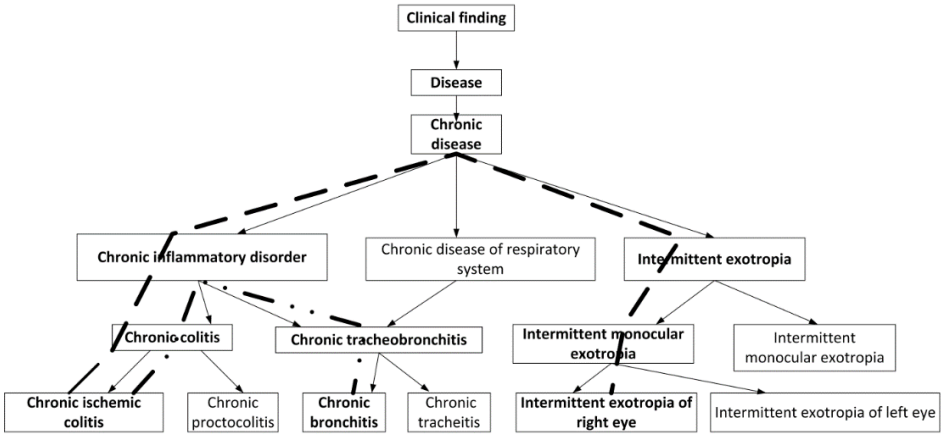


Fig. 3 Illustration of how distance in knowledge taxonomy influences the difficulty of the question

5. Architecture and Implementation Overview

The main components, their interactions and basic principles of the proposed approach are illustrated in Figure 4.

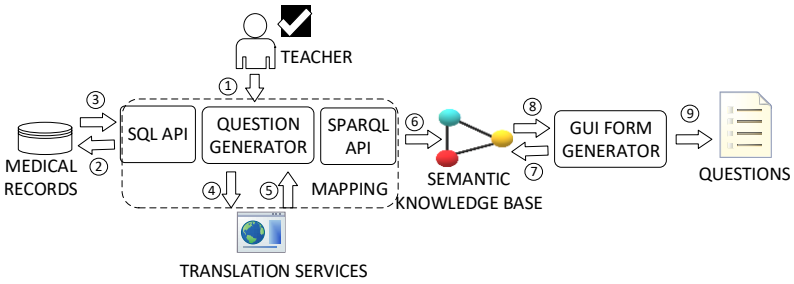


Fig. 4 Solution overview: 1-Difficulty and language settings 2-SQL queries 3-SQL query results 4-Translation service call 5-Translation results 6-RDF triplets 7-SPARQL queries 8-SPARQL query results 9-Question GUI form

First, teacher selects the question difficulty level, inputs the diagnosis name and sets the target language. After that, for each of the ontology properties, question generator executes queries against the relational medical record database using SQL API in order to retrieve the necessary question property values. The medical record database used in this paper contains lab results, diagnostic and medication details of a large number of patients collected during ten years. It is available online as a public, free-to-use dataset on data.world[2]. It contains data about 3063 medical encounters, 7509 lab results and 1176 medical fulfillments.

In Table 1, full mapping between the medical record database and ontology property values is described. The first table column denotes the name of column(s) from the medical database used for mapping. The second column shows the filtering criteria against the previous database columns used for mapping. The third table is the name of ontology property that is being mapped. To each of entries from Figure 1, SQL query similar to the previously given example is formed. These mapping queries are executed when knowledge about given input diagnosis has to be constructed.

Table 1 Mapping between medical record database and OntoCIP ontology

Medical record database column	Filtering criteria	Ontology property
encounter_dx.description	encounter_dx.description= '*input diagnosis'*	hasDiagnosis
encounter.soap_note	encounter_dx.description= '*input diagnosis'*	hasAppropriateME
lab_results.result_description	(lab_results.result_name LIKE '%X-Ray%' or lab_results.result_name LIKE '%ECG%') and encounter_dx.description='*input diagnosis'*	hasAppropriateCHECG
lab_results.result_name lab_results.result_description	encounter_dx.description='*input diagnosis'*	hasAppropriateLAB
medication_fulfillment.drug_name medication_fulfillment.sig	encounter_dx.description='*input diagnosis'*	hasAppropriateTR

6. Evaluation and Results

In this section, the performance evaluation of the proposed framework for automated, ontology-based generation of questions for multilingual assessment in medical education is given and compared to the time needed for manual creation of the same questions. The evaluation was performed on a laptop equipped with Intel i7 7700HQ CPU, 16GB DDR4 RAM and 1TB HDD, running on Windows 10. The backend of the platform for code generation was entirely written in Java, while the ontology management, triplet insertion and querying were done using TaaSOR online service and its Java API (Tosic et al., 2012).

[2] https://data.world/arvin6/medical-records-10-yrs

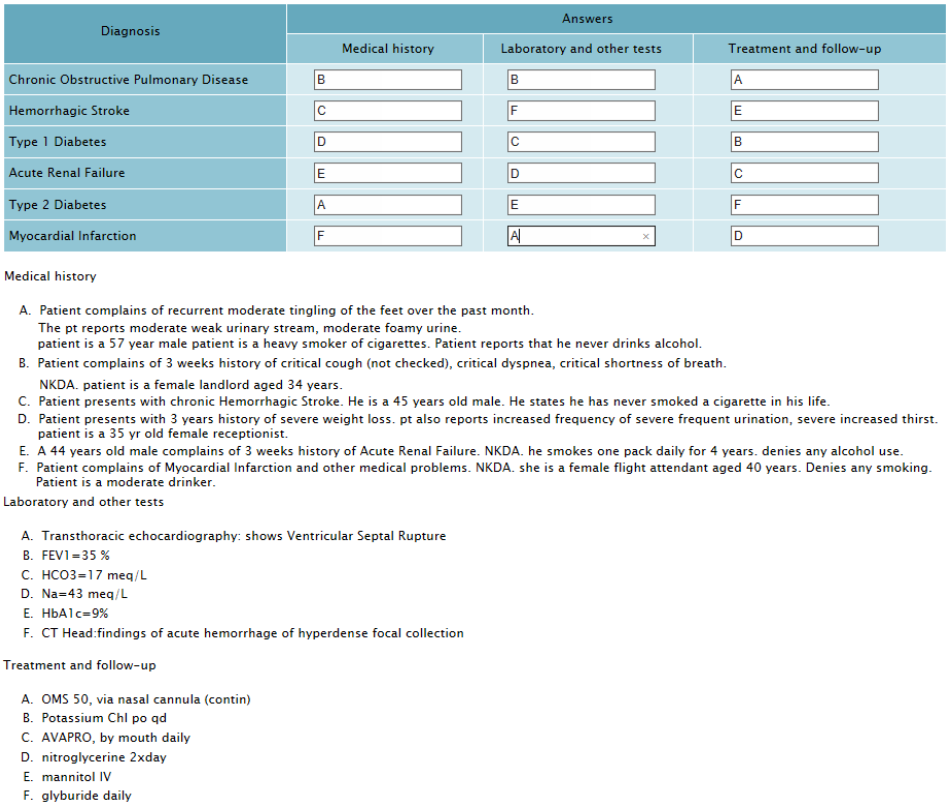
In Table 2, the achieved results are given. The first column shows the number of diagnoses present within the puzzle. The second column contains the time necessary for execution of SPARQL queries against the medical records database during the process of mapping. Moreover, the third column is the time spent for generation of candidate diagnoses according to the pre-selected difficulty level based on similarity. The fourth column presents the time needed for insertion of corresponding triplets into the semantic knowledge base with respect to given question ontology. Furthermore, the fifth column is the time needed for generation of corresponding question's visual representation (HTML web page containing table for puzzle representation in our case). The sixth columns is the question's target language. Finally, the last column is the total time needed for automated question generation, obtained as a sum of previous four times columns.

Table 2 Evaluation results for automated generation of questions using OntoCIP ontology

Number of diagnoses	SQL queries [s]	Candidate generation [s]	Triplet insertion [s]	Page generation [s]	Target language	Total time [s]
4	0.98	0.089	0.163 1.624	0.038	English Italian	1.270 2.731
5	0.96	0.091	0.208 1.881	0.040	English Italian	1.299 2.972
6	0.99	0.092	0.208 2.015	0.044	English French	1.334 3.305
7	1.02	0.094	0.211 2.427	0.048	English French	1.373 3.589

In Figure 5, a screenshot of the web page containing the generated question for evaluation purposes in English is given. According to the achieved results, it can be noticed that the total question generation time increases with the number of diagnoses considered, but it does not exceed order of magnitude of 1 in our experiments (from 4 to 7 diagnoses per question). Furthermore, it can be noticed that triplet insertion is much longer (up to more than 10 times) when target language is not English. It can be explained by the fact that in cases when other target language is selected, an online translation service is used, which introduces additional delay. In this study, we have used translation service Yandex instead of widely adopted Google Translate because the usage of its programmatic interface in third party applications is still entirely free unlike Google Translate API. Moreover, it was shown that Yandex Translate outperforms Google Translate in some cases (Bülbül et al., 2020).

Compared to manual procedure of CIP question construction, the proposed approach obviously speeds up the process which usually takes 1-2 hours for puzzle with 7 diagnoses (van Bruggen et al., 2012). Moreover, it also has huge potential to reduce costs and time, as manual procedure usually requires several experts (around 4-7 if not the whole team for each of the Sections), while multilingual assessment is enabled, which requires much more efforts for manual construction.



Diagnosis	Answers		
	Medical history	Laboratory and other tests	Treatment and follow-up
Chronic Obstructive Pulmonary Disease	B	B	A
Hemorrhagic Stroke	C	F	E
Type 1 Diabetes	D	C	B
Acute Renal Failure	E	D	C
Type 2 Diabetes	A	E	F
Myocardial Infarction	F	A	D

Medical history

A. Patient complains of recurrent moderate tingling of the feet over the past month.
The pt reports moderate weak urinary stream, moderate foamy urine.
patient is a 57 year male patient is a heavy smoker of cigarettes. Patient reports that he never drinks alcohol.
B. Patient complains of 3 weeks history of critical cough (not checked), critical dyspnea, critical shortness of breath.
NKDA. patient is a female landlord aged 34 years.
C. Patient presents with chronic Hemorrhagic Stroke. He is a 45 years old male. He states he has never smoked a cigarette in his life.
D. Patient presents with 3 years history of severe weight loss. pt also reports increased frequency of severe frequent urination, severe increased thirst.
patient is a 35 yr old female receptionist.
E. A 44 years old male complains of 3 weeks history of Acute Renal Failure. NKDA. he smokes one pack daily for 4 years. denies any alcohol use.
F. Patient complains of Myocardial Infarction and other medical problems. NKDA. she is a female flight attendant aged 40 years. Denies any smoking.
Patient is a moderate drinker.

Laboratory and other tests

A. Transthoracic echocardiography: shows Ventricular Septal Rupture
B. FEV1=35 %
C. HCO3=17 meq/L
D. Na=43 meq/L
E. HbA1c=9%
F. CT Head:findings of acute hemorrhage of hyperdense focal collection

Treatment and follow-up

A. OMS 50, via nasal cannula (contin)
B. Potassium Chl po qd
C. AVAPRO, by mouth daily
D. nitroglycerine 2xday
E. mannitol IV
F. glyburide daily

Fig. 5 Screenshot of generated CIP question in English

7. Conclusion and Future Work

The medical students enrolled in medical schools all around the world are going to become the doctors of tomorrow, carrying values, skills and hopes for the profession into the future. Medical education today represents the cornerstone of the overall medicine in future. As a Lingua Franca, knowledge of English language has become imperative for students of medicine particularly in a highly connected and globalized world where medical crises travel around the world in an unprecedented speed. Therefore, multilingual medical education, where different native languages are used together with English language, represents the key enabler for addressing the urgent need for new generation of medical personnel.

As one of the crucial parts of medical education, assessment methods must be able to address the new challenging circumstances. Artificial Intelligence represents a promising approach, particularly adoption of ontologies that have powerful knowledge representation and reasoning capabilities. However, in addition to new technologies, new advanced assessment methodologies are required as well. CIP represents one such assessment method with a strong discriminatory quality. In other words, CIP items exhibit minimal false-

positives (cases when students answer the item correctly even though they do not have necessary knowledge or competence) and false-negatives (cases when students give wrong answers even though they have relevant knowledge or competence). The novelty and widespread adoption of this assessment method highlight the need for automatic generation because time consuming manual construction is not a practical option.

In this paper we have presented one possible solution for automated question generation based on reasoning about domain knowledge represented by ontologies. Ontologies are used for domain knowledge as well as questions type conceptualization so that assessment is done at the conceptualization and reasoning level. Because ontologies allow annotation of concepts in different languages, domain questions outgrow domain knowledge assessment, that is traditionally their primary purpose, and become a new advanced tool for language for specific purposes teaching. In this paper, we primarily have been focused on teaching English for specific purposes, but the proposed approach can be equally effectively applied to other languages as well. In this way, domain specific problem solving is integrated into the language for specific purposes teaching.

First, OntoCIP ontology is developed to semantically represent structure and methodology of the CIP assessment method. After multilingual ontology mapping from medical relational database to OntoCIP ontology, automatic generation of question's visual representation is performed by populating the question template. The main components of the proposed architecture as well as implementation overview are explained. Conducted evaluation shows that proposed approach significantly reduces teachers' time for multilingual CIP generation. In our future work, we plan to develop an open access online service that would provide the proposed concept to a global community as a knowledge sharing platform. We envision a heterogeneous community that would include language experts, domain experts, practitioners, and students, but eventually institutions and organizations as well.

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THE USE OF DIGITAL TECHNOLOGY IN ESP: CURRENT PRACTICES AND SUGGESTIONS FOR ESP TEACHER EDUCATION

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Abstract. *Developments in Information and Communication Technology (ICT) have transformed the way people communicate, interact and also the way they learn. ICT tools are widely used in language teaching and learning, and the benefits have been repeatedly expressed in literature. ESP is yet another area of language education that has been affected by these developments. Despite the fact that there are ESP practitioners who utilise technologies in their teaching, more research is needed in order to identify how widely technology tools are used in ESP, so that action is taken to empower practitioners and provide them with the help they need in order to integrate technology in their practices. This paper reports on the findings of a study conducted among 67 ESP practitioners from Tertiary Education in Greece and the Republic of Cyprus, the data of which were obtained through the use of an electronic questionnaire. The paper aims at examining the profiles of ESP practitioners in Greece and the Republic of Cyprus describing their use of technology (hardware and software) for the preparation and delivery of their courses. Furthermore, it outlines ESP practitioners' views on the inclusion of a component on the use of technology in ESP teacher education. The paper concludes with suggestions regarding opportunities for professional development on issues related to the integration of ICT tools in ESP teaching and learning.*

Key words: *ESP, Information Communication Technologies (ICT), Social Constructivism, Connectivism, ESP Teacher Education*

1. INTRODUCTION

The use of technology in language teaching and learning has undergone a dramatic change in the last 30 years, a change which is also evident in the vocabulary used to describe it. From the advent of Computer Assisted Language Learning (CALL) that reached its peak in the 1980s, focus has shifted to Technology Enhanced Language Learning (TELL), and today's literature revolves around the integration of Information and Communication Technologies (ICT) in language education (Dudeney and Hockly 2012). Since the 1980s a lot of developments have taken place in ELT including developments in hardware and software. According to Dudeney and Hockly (2012), integration of technology began with the use of word processors, text reconstruction, simple games and simple feedback, and learners could only interact with the text rather

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than produce language in a communicative manner. With the advent of the internet in the 1990s, and later on with Web 2.0, things changed since learners had access to online resources and tools for synchronous and asynchronous communication such as chat and email; then followed the formulation of WEbQuests (internet-based enquiry activities), websites and different resources for teachers, online discussion groups, virtual learning environments, blogs, wikis, Interactive Whiteboards, social networks, mobile devices, etc.

Nowadays, the use of ICT in education in general, and language education in particular, has proceeded with the creation of Massive Open Online Courses (MOOCs), communities of practice (CoPs) and Open Educational Resources (OERs) and tools such as Learning Management Systems (LMSs), cloud technologies, and artificial intelligence systems. Technological developments and innovations are reflected in the work published in Journals specialising in the use of technology in language learning and teaching, i.e. *ReCALL*, *CALL*, *CALICO*, *Language Learning and Technology*, etc. These advances are also evident in the work of the European Commission to empower people with the use of digital technologies (European Commission 2020) and the launch of more EU-funded research and innovation projects, such as the Digital Competences for Language Teachers (DC4LT) (DC4LT Consortium 2019).

The field of Languages for Specific Purposes (LSP), and more specifically English for Specific Purposes (ESP) has not remained unaffected by all these shifts in the field of language teaching and learning. This paper presents a study on the use of ICT tools by a group of 67 Higher Education (HE) and Vocational Education (VE) ESP practitioners in Greece (Gr) and the Republic of Cyprus (RoC), analysing their needs in terms of ESP teacher education and eliciting their views on the matter. Based on the findings of the study, the paper concludes with useful suggestions for ESP professional development opportunities in the integration of technologies in ESP practices.

2. WHY GO DIGITAL?

Despite all the practical challenges, nowadays technology constitutes one of the main sources of learning. Among the most influential learning theories in the last years is social constructivism, according to which knowledge is constructed through the interaction of the existing knowledge with new ideas and experiences and through interaction with social environment (Vygotsky 1978). In the age of the fourth industrial revolution (Hirschi 2018), social constructivist approaches can only be applicable through the use of technologies. Another prevailing learning theory nowadays is connectivism, according to which learning is achieved through networking, in other words establishing connections with other professionals or resources (Siemens 2005). Since technology plays a central role in the establishment of such networks, its use in all aspects of education is of paramount importance for learning to take place.

ESP by definition concentrates on specific language needs of learners; thus, the use of technologies is even more important, as they can become a source of authentic materials, opening a window to the world and exposing the learners in real life language use in their specific disciplines. The need to integrate technologies in the ESP classroom is more intense nowadays, as students need to be engaged in the learning process and build their image as global citizens. According to Deacon, Parkin, and Schneider (2017, 137), "[i]t is now widely accepted that universities have a direct responsibility to prepare students for

employment and in the 21st century, this preparation needs to include digital literacy and competencies". Furthermore, technology could serve as a place for publishing and sharing work and a means of communication between all the participants in the learning process (e.g. through social media, online meeting platforms and cloud technologies) (Bloch 2013; Arnó-Macià 2014). Technologies also promote learner autonomy (Blin 2012), and they create opportunities for communication and engagement in partnerships with stakeholders worldwide (Arnó-Macià 2012).

Therefore, technology should have a central position in ESP, and LSP in general, teaching and learning processes. There are many tools and applications that ESP practitioners could integrate in their courses (Bloch 2013); these could prove useful and efficient, should they be directed by the pedagogies governing each course.

2.1. Technology and ESP today

In this context of continuous social, economic and political transition, many developments are occurring in the field of ESP pertaining to the use of technology in the ESP teaching and learning processes (Dashtestani and Stojković 2015).

Among the latest developments in the ESP field is ESP practitioners' and students' involvement in telecollaboration projects (Sevilla-Pavón and Haba-Osca 2017; Bohm, Koeper-Saul, and Mossmann 2019) that foster real-life communication and enhance intercultural awareness. Another advancement in ESP is the use of VR or immersive virtual reality that enables the creation of entirely digital environments and augmented reality (AR) that enhances reality with digital resources (Bonner and Reinders 2018). Additionally, serious gaming, which involves gaming with a primary purpose other than entertainment, has been used in ESP; the integration of the serious game *Escape From Desolo* in the course English for Shipping (Safety at Sea component) at the Cyprus University of Technology is one such example (Pappa and Papadima-Sophocleous 2019). Cloud computing is yet another type of technology used in ESP, with a focus on how "pedagogy implemented to support such tools, might generate greater participation and interaction between students, and between students and their teachers" (Heggart and Yoo 2018, 140). An example of employing cloud technologies in ESP is the use of the G Suite for Education, in two English for Specific Academic Purposes at the Cyprus University of Technology (Kakoulli Constantinou 2018; Kakoulli Constantinou 2019). Last but not least, the employment of social media, such as Twitter, in ESP (Plutino 2017; Rosell-Aguilar 2018) is another advancement in the ESP field that has linguistic, cultural and social benefits.

Recent literature in the use of technology in ESP shows that ESP practitioners make efforts to integrate technology tools in their teaching practices with positive results. Nevertheless, it is worth exploring whether the use of technology is a common practice amongst ESP practitioners, identify challenges that they may face and suggest ways that could potentially help practitioners incorporate technology in their practices. This is the focal point of this paper.

3. The Research Study

3.1. The rationale and purpose of the study

The impetus for the study was the researchers' personal experience in teaching ESP. Being experienced ESP practitioners, the researchers were aware of the challenges ESP practitioners in general faced in their teaching practice and the value of utilising technology inside and outside the classroom. Moreover, they recognised ESP practitioners' need for more ESP teacher education opportunities, especially as far as integrating technologies in their practice is concerned. Therefore, the research study aimed at delineating the profiles of HE and VE ESP practitioners in Greece and the Republic of Cyprus, focusing on their needs in terms of ESP teacher education. The purpose was to provide suggestions on how the situation could improve. The present paper concentrates on the data elicited from the study that relate to the practitioners' use of technology (hardware and software) for the preparation and delivery of their courses as well as their students' use of technology in their ESP courses. Furthermore, the paper outlines ESP practitioners' views on the inclusion of a component on how to use technology in ESP teacher education.

3.2. The research questions

The research questions that the researchers attempt to provide answers to were the following:

1. What are the duties of ESP practitioners in HE and VE in Greece and the Republic of Cuprus?
2. How frequently do these ESP practitioners use technologies in their teaching practices?
3. What technology tools do they employ in their ESP practices?
4. What are their views on including training on using technology in ESP teacher education?

3.3. Methodology

The study mainly employed a quantitative methodology of gathering and analysing data. The tool that was used for the collection of data was an electronic questionnaire that was administered using Google Forms. The questionnaire consisted of closed-ended questions (Multiple response and Likert Scale) and open-ended questions that were generated based on a review of the literature, previous research in the field of ESP teacher education and language teacher education in general (Crocker 1981; Ur 1996; Dudley-Evans and St. John 1998; Harmer 2001; Chostelidou, Griva & Tsakiridou 2009; Thaine 2010) as well as the researchers' personal experience as ESP practitioners. The questionnaire was reviewed by three external researchers and was pilot-tested with 8 ESP practitioners in the Republic of Cyprus HE institutions, and the appropriate changes were made before it was administered to the participants. The data obtained were analysed using the IBM Statistical Package for the Social Sciences (SPSS).

3.4. Participants

A total of 67 ESP practitioners form HE and VE in Greece and the Republic of Cyprus (56,71%, n=38 from Greece and 43,28%, n=29 from the Republic of Cyprus) participated in the research, the majority of whom were middle-aged female teachers with more than six years of ESP teaching experience, as shown in Table 1.

Table 1 Profile of ESP practitioners

		N	Percent
Sex	Female	58	86,6%
	Male	9	13,4%
Age	20-29	1	1,5%
	30-39	20	29,9%
	40-49	21	31,3%
	50-59	19	28,4%
	60 or more	6	9,0%
Years of ESP experience	1-5	7	10,4%
	6-10	18	26,9%
	11-15	11	16,4%
	16-20	10	14,9%
	Over 20	21	31,3%
	Total	67	100,0%

3.5. Results and discussion

The results of the data elicited from the study revolved around 1) the duties of ESP practitioners; 2) the use of technology in their ESP courses; 3) issues related to ESP teacher education.

3.5.1. ESP practitioners' duties

In order to establish the profile of the ESP practitioners who participated in the study, apart from the demographic information obtained, participants were asked to state their duties as ESP practitioners through a multiple-responses question. As Table 2 illustrates, ESP practitioners had a wide range of responsibilities, with almost everyone being involved in teaching and almost half being involved in research.

Table 2 Duties of ESP practitioners

Duties	N	Percent	Percent of cases
Course Design	61	19,2%	91,0%
Teaching	66	20,8%	98,5%
Materials Selection	59	18,6%	88,1%
Materials Development	60	18,9%	89,6%
Course Evaluation	39	12,3%	58,2%
Research	33	10,4%	49,3%
Total	318	100,0%	474,6%

The fact that ESP practitioners have multiple tasks to perform was originally reported in the literature by Dudley-Evans and St. John (1998) and later on by Johns (2013). The use of technology in this context is crucial, as it could facilitate all of the above processes providing practical assistance, being an infinite source of information and fostering communication and interaction (Bloch 2013; Arnó-Macià 2014).

3.5.2. Use of technology

The ESP practitioners that participated in the study stated that they made use of technology frequently, as according to the responses, the majority always utilised technology in their ESP courses (44,78%, n=30) or very frequently (35,82%, n=24), while only 17,91% (n=12) of the practitioners used technology occasionally, and just 1,49% (n=1) never used technology at all.

Identifying the different technologies/tools (hardware and software) they used for both course preparation and course delivery, the ESP practitioners indicated the following:

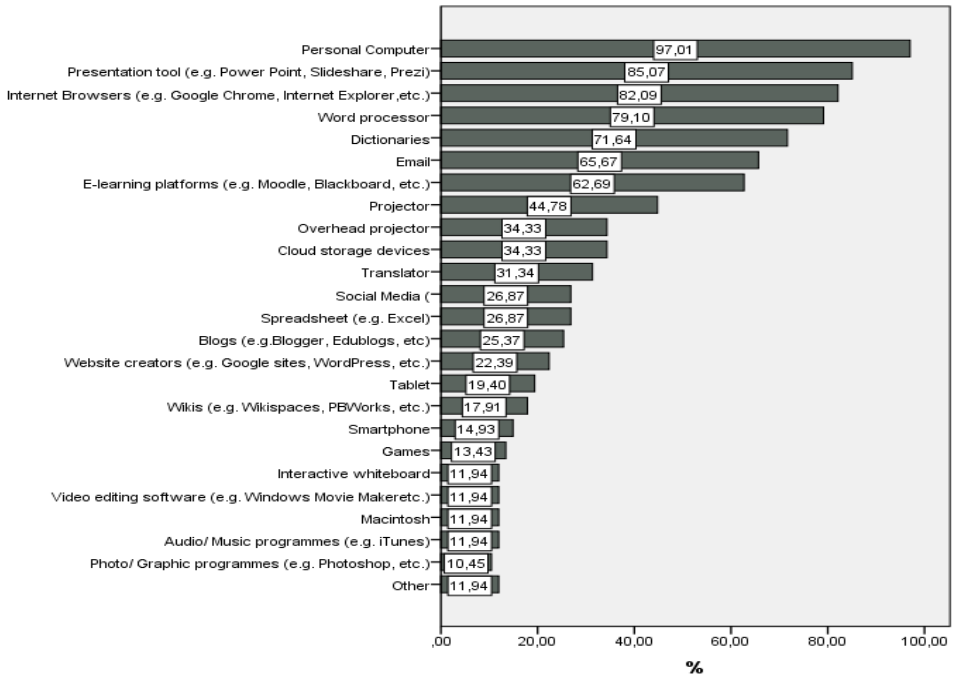

Fig. 1 Technologies used for course preparation

As far as course preparation is concerned (Figure 1), almost all of the participants used their PCs to prepare their courses, and a vast majority of them also used tools such as the Power Point for the same purpose. Furthermore, tools such as internet browsers, word processors, dictionaries, email and e-learning platforms also appeared to be very commonly used tools for course preparation among ESP practitioners in HE and VE. The tools which appeared to be the least popular for the preparation of courses were tools like games,

interactive whiteboard, video editing software, audio/music programmes and photo editing software.

Regarding the technologies used for the delivery of ESP courses (Figure 2), the results were the following:

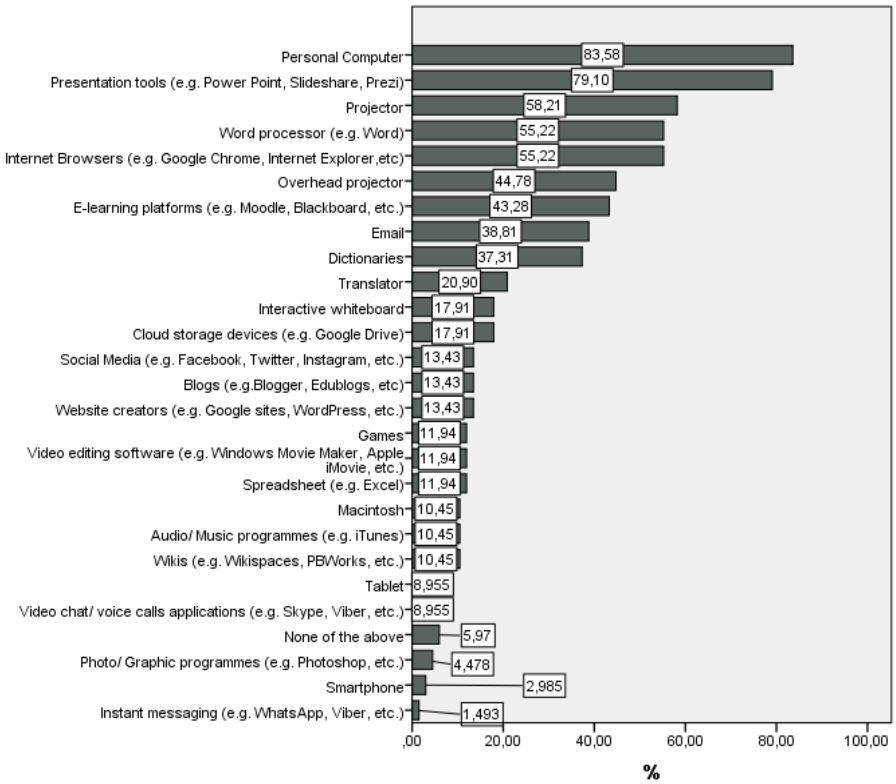

Fig. 2 Technologies used for course delivery

Even though the ESP practitioners appeared to integrate different tools in their teaching practices, the percentages of practitioners who actually utilised technologies for the delivery of their courses were lower than those of the practitioners who used technologies to prepare their courses, as presented in Figures 1 and 2. As in the case of course preparation, the PC and presentation tools were identified as the most popular tools for course delivery, along with projector, word processor, internet browsers, overhead projectors, e-learning platforms, email and dictionaries. On the other hand, tools like social media, blogs, websites, games, wikis, chat tools or smartphones were not listed as popular tools for the delivery of ESP courses among Cypriot and Greek ESP professionals.

Drawing from the above, it could be assumed that ESP practitioners mainly used basic technology tools, instead of more advanced technologies. The reason for this could be the fact that they might feel more comfortable with using tools that they were already familiar with, and that they probably lacked the necessary training. Another possibility

could be the lack of the necessary equipment. Since according to recent theories of learning (i.e. social constructivism and connectivism) knowledge is constructed through communication and interaction, it is essential that ESP professionals become acquainted with such technologies.

Furthermore, ESP professionals were also requested to state how often they asked their students to use technology for the course. Almost 48% (n=32) responded that they did that very frequently, whereas 26% (n=17) said that they always did. Few were the practitioners who responded that they asked their students to use technology occasionally (19,40%, n=13), rarely (5,97%, n=4) or never (1,49%, n=1). These results prove that ESP practitioners in fact encouraged the use of technology among their students.

ESP practitioners were also asked to name which technologies were used by students in their ESP classes (Figure 3):

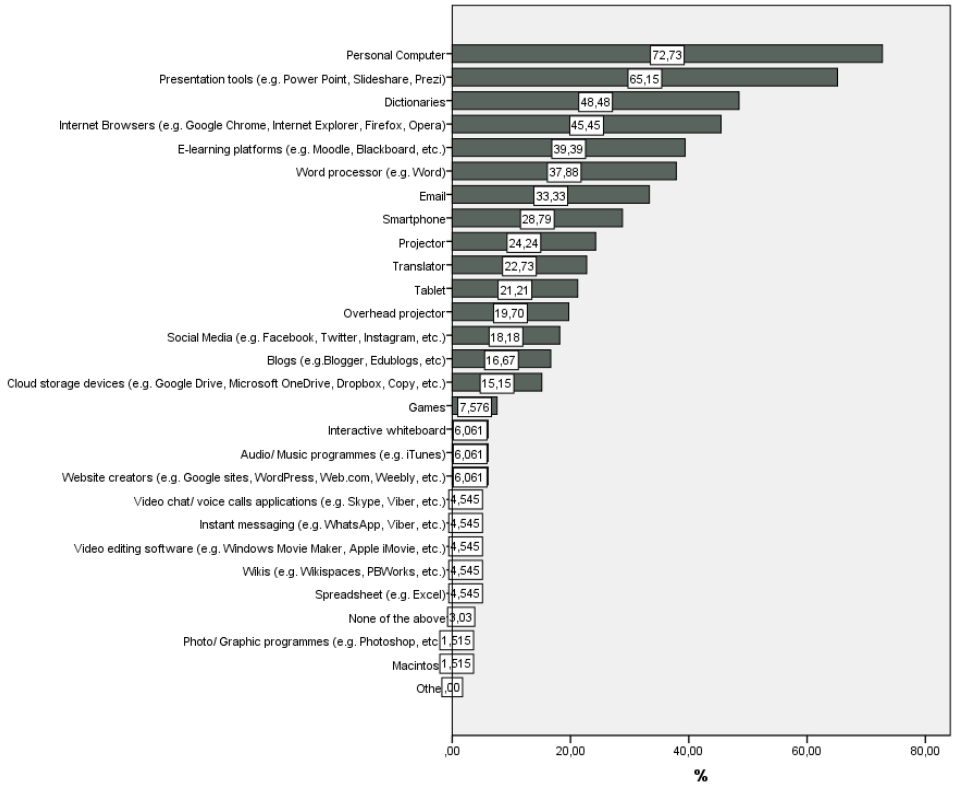

Fig. 3 Technologies used by students for ESP learning in class

ESP practitioners stated that their students used PCs, presentation tools and dictionaries, and they also employed internet browsers, e-learning platforms, word processor, email and smartphone in their learning. These results lead to the conclusion that instructors made less use of social media tools and generally tools that involve sharing, e.g. blogs, cloud storage devices, than students. The reason for this might be the fact that students use such technologies in their everyday life, and they might be more familiar with their use. Moreover,

these findings reinforce the assumptions that ESP practitioners might lack training in integrating technologies in their teaching practices or that they were not provided with the appropriate facilities or support in order to be able to use a variety of tools in their classes.

Nevertheless, in spite of the above results, ESP practitioners appeared to realise the significance of using technology in ESP, as the majority acknowledged the use of technology in ESP teaching as important or very important, while the percentage that considered the use of technology as moderately important or little important was small (Figure 4). These results are in agreement with Dogoriti and Pange's (2012) study, which showed that ESP practitioners in Greece were positively oriented towards the idea of making more use of technology in their practices, despite the fact that they mostly used basic technology tools.

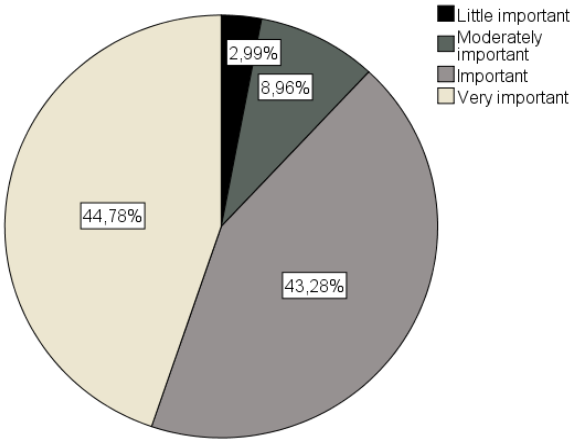

Fig. 4 Importance of using technology for ESP practitioners

3.5.3. Suggestions for ESP teacher education

Apart from the effort to describe ESP practitioners' use of technology, the questionnaire also aimed at identifying their needs in terms of ESP teacher training. According to the results, the needs that were mentioned by most of the practitioners were the following: using technology was regarded by 34,33% of the participants as one of the aspects in which they needed improvement along with collaboration with subject specialists and colleagues (58,21%), development of learners' productive skills (47,76%), designing activities and tasks (38,81%), having specialised knowledge on the matter (35,82%) and selecting materials and resources and teaching methodology (34,33%). These may constitute the main areas on which future endeavours in ESP teacher education could concentrate.

The fact that ESP teacher education on issues related to using technology in ESP teaching and learning is needed is also evident in Figure 5.

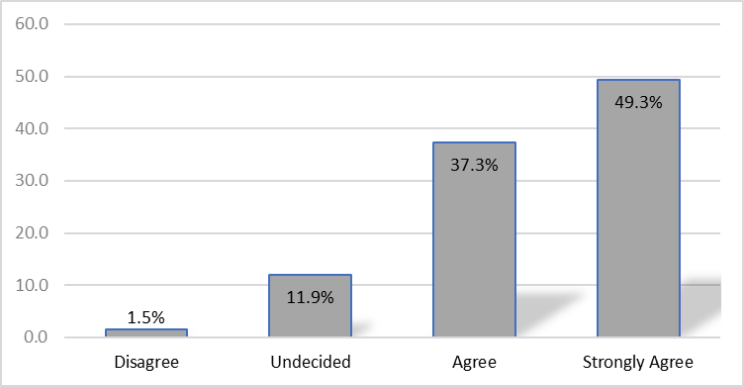

Fig. 5 ESP practitioners' view on including ways of teaching with technology in ESP teacher education

Almost 90% of the participants agreed with including ways to teach with technology in ESP teacher education courses, a fact that reinforces the assumption that ESP practitioners regard the use of technology as important in the ESP teaching practice and shows that they are positively oriented towards receiving training on the use of technology. This intense need for teacher education on the use of technology in ESP was also expressed in other research studies in different educational contexts (Vukicevic-Dordevic 2015; Kniazian and Khromchenko 2019).

4. Conclusion

This paper aimed at examining the use of ICT tools in the teaching practices of HE and VE institutions ESP practitioners in Greece and the Republic of Cuprus. The results of the study showed that the majority of the practitioners had multiple duties to address, which made the use of technology even more important. Additionally, the study showed that even though ESP practitioners used technology in their courses regularly, the ICT tools that they employed for both the preparation and the delivery of their courses were basic, while the majority appeared hesitant to make use of more specialised and advanced tools. Nevertheless, they encouraged the use of technology among their students. All the above, in combination with the fact that most of them appreciated the value of using technology in ESP and were positively oriented towards receiving more education on the matter, lead to the conclusion that more opportunities for ESP teacher education on issues pertaining to the use of technology are needed.

The fact that research in the area of ESP practitioners' needs analysis is restricted and that the need for more efficient and systematic ESP teacher education is intense, make this research study valuable, despite the fact that it is only confined to the ESP context in Gr and the RoC. ESP practitioners are in need of ESP teacher education on issues of teaching methodology, particularly the use of technology, and this is also evident in results from other studies around the world (Vukicevic-Dordevic 2015; Kniazian and Khromchenko 2019). Teacher education opportunities need to be systematic and

continuous since developments in technology are constant. Therefore, ESP practitioners need more than just occasional training workshops in order to keep themselves updated on the latest developments in the field. Participation in professional networks could prove very useful, as they correspond with the latest learning theories of social constructivism and connectivism, which have also affected ESP teacher education processes. Such networks could involve participation in professional organisations related to ESP or CALL/TELL or different communities of practice (CoPs). Moreover, more ESP teacher education programmes should be offered which include components on incorporating ICT tools in ESP teaching and learning. Finally, institutions should provide ESP practitioners with the necessary equipment and technical support in order to be able to apply these technologies in the teaching and learning processes.

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SEMANTIC MOTIVATION OF THE TERMINOLOGIZED LEXIS IN THE FIELD OF DIGITAL TECHNOLOGIES

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Abstract. *Digital technologies are changing people's lives, the way we communicate, learn and work. Modern language teaching technologies are changing the ways we learn languages as well. On the other hand, the language itself is changing as technology advances. The aim of this article is to reveal semantic motivation of terminologized Lithuanian and English computer lexis. The present research, focusing on semantic motivation of IT terms, is also aimed at identifying similarities and differences between the semantic models of the words in both contacting languages, and revealing the factors that determine the choice of foreign sememes. In addition, the article sheds some light on semantic relations of IT terms, as well as on tendencies in the shifts of meanings of specific LT and EN common language words, related to the process of terminologization. It has been established that the majority of the analysed words that have entered the Lithuanian IT vocabulary as a result of terminization and transterminization processes can be considered semantic loan-translations, having acquired new meanings from foreign (usually English) words, and based on 'borrowed' motivation. Nonetheless, many such words can also be substantiated in Lithuanian, for their terminological meanings can be explained by central, nonterminological meanings. Thus, in the majority of cases, close associations between central meanings of specific English and Lithuanian words have stimulated the development of new terminological meanings related to information technologies. By contrast, only a relatively small number of the analysed Lithuanian terms can be considered semantic formations, having acquired their terminological meanings in the process of turning Lithuanian common language words into terms.*

Key words: *digital/IT terminology, semantic motivation, semantic loan-translations, terminologization*

1. INTRODUCTION

The aim of this article is to reveal semantic motivation of terminologized Lithuanian and English computer lexis. The present research, focusing on semantic motivation of IT terms, is also aimed at identifying similarities and differences between the semantic models of the words in both contacting languages, and revealing the factors that determine the choice of foreign sememes. In addition, the article sheds some light on semantic relations of IT terms, as well as on tendencies in the shifts of meanings of specific LT and EN common language words, related to the process of terminologization.

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New words are constantly being created and recreated, especially when it comes to a huge amount of new computer related realities. On the other hand, only by understanding the meaning of these terms is it possible to make professional use of these technologies. It has been noticed that most Lithuanian terms in computer science have semantic values of the English language (M. Paura, 2014; A. Kaulakienė, 2001, 2008, etc.). The choice of such foreign-language sememes is determined by the similarities and differences between the semantic models of Lithuanian and English words. Whether the new term, which is based on borrowed motivation will come into play in language will depend on how well it is motivated in the Lithuanian language. It is also important, how well its terminological meaning is based on the former non-terminological meaning.

Motivation is usually defined as a psychological feature and condition that determines the activity and directionality of a person in a particular situation (Albrechto 2005: 110). It triggers a particular behaviour, actions, and particular activities, and is caused by a variety of motives. In linguistics, motivation is understood as the semantic-structural feature of a word that allows one to perceive the relation between its meaning and its formal composition (Jakaitienė 2010: 26). A 'motivated' word means the word that can be explained and is well-founded, for instance, *branch*, when used meaning *department*, it is motivated by the meaning of the word *branch* – tree brunch. The attribute 'branchness' becomes important in the motivation of the 'department' concept. The internal form of the word and the motivating sign reflect the attitude of a person towards the object being named. By revealing a motivating attribute, it is possible to explain how a phenomenon or object receives one or another name on the basis of certain attributes and how this complexity of factors affects human subconsciousness.

Terminologists consider motivation to be one of the basic attributes of a term. It is easier to remember a motivated term and to associate it with other terms, but this requirement, according to J. Gaivenytė (2000: 19) is to be regarded as additional only, since the positioning of the term in the system can be determined from its definition, and the essential characteristic is not always chosen as a motivating factor. Motivation can also be determined by random associations. Though semantics and motivation of the term are important, it is also important to remember that a term is rather a matter of agreement. The term is a specific unit of lexis, and its motivation has certain peculiarities.

Motivation of terms as a linguistic aspect has not received assiduous attention of Lithuanian linguists so far. J. Gaivenytė (2000: 19-25), having analysed Lithuanian compound nominative terms related to the field of physics and their English equivalents, noticed that Lithuanians had mostly adopted the concepts and terms related to the field of physics, because only about half of the terms could be considered of the Lithuanian origin. A. Gritėnienė (2006) studied motivation of plant names and focused on tendencies of coining the names, usage, dissemination of names, novelty, and the origin of certain borrowed terms. J. Lubienė (2008) investigated names of funguses as one-word terms, the motivation of which, as it was found out, is determined by external and internal qualities of funguses. The study of geographical terms coined by J. A. Pabrėža, carried out by R. Gedrimas (2003), includes a section on analysis of semantic formations. E. Jakaitienė (1988), K. Gaivenis (2002), and S. Keinys (2005) have also explored aspects of semantic formations in their works.

The semantics and motivation of informatics and computer terminology have been analysed more thoroughly in publications by A. Kaulakienė (2001, 2008). The researcher has investigated and evaluated the spread of semantic formations and loan-translations in the basic computer terminology, paying more attention to the development of the lexical

items such as *computer, hardware, software, microsystem*, etc. The semantic field consisting of the words that describe the concept of *computer virus* was investigated in the dissertation by M. Paura (2014). In some of his works, M. Paura (2008) has also noticed the tendency to turn common Lithuanian words into terms. In his opinion, this tendency could be regarded as an example of attributing new meanings to the existing Lithuanian words (Paura 2008). V. Celiešienė (2016) has focused on the extent to which this tendency is generally typical of the Lithuanian terminology related to the field of information technologies and has noticed that shifts in the meanings of specific common Lithuanian words can be considered factors driving the creation of new computer terms.

Methods of description, comparison, and oppositions have been applied in this study. The concept properties are differentiated with regard to logical linguistic concept comparative methods according to the definitions provided in dictionaries.

The sample of the research consists of simple Lithuanian terms that have originated in the processes of terminologization and transterminologization, included in the *Encyclopaedic Dictionary of Computer Terms* (EKŽ), and the corresponding English words in *EuroTermBank* (ETB) and *Encyclopedia. The Computer Language Company Inc.* (PCmagE). The online resource "The Encyclopaedic Dictionary of Computer Terms" (EKŽ) has been selected as the primary source of terms for analysis. This resource includes about 4.6 thousand entries. The current research has focused on simple terms (one-word lexical units, nouns) included in EKŽ; the resource contains 917 such lexical units. It has been found that 58 percent of simple terms included in this Dictionary are of the Lithuanian origin, and 16 percent of the units out of the mentioned percentage can be considered semantic loan-translations. These reliable sources provide comprehensive definitions of terms. The study focuses on simple semantic formations and semantic loan-translations. These units are common language words that have been turned into IT terms or have been adopted from other subject areas. According to M. Paura (2008), such words are only seemingly simple, as in the field of information technologies they are provided with definitions, which separates them from the commonly used linguistic items and turns them into units of specialized lexis.

2. Theoretical Background

Each language consists of motivated and unmotivated words. The meaning of unmotivated words is primary, thus it cannot be explained by other words, whereas the meaning of a motivated word can be easily explained by comparing it to the meanings of related words (Gritėnienė 2006: 24). Thus, motivation is one of the most important factors influencing the information carried by a word. Motivated and unmotivated distribution of words in a language is a semantic universality. It can be stated that there is no such a language that would consist of motivated words only and would not include any metaphors, etc. According to S. Ullmann "[t]hree motivation types can be applied in English and many other languages: phonetic, morphological, and semantic. A phonetic word similarity to natural sounds related to a signifier is considered phonetic motivation; morphological (or formation) motivation is based on the choice of the sound expression of the word for its content; semantic – the emergence of a new (metaphorical or metonymic) meaning of the word used figuratively. Morphological and semantic motivation should be considered "relative". In the first case, motivated words may contain non-substantiated morphemes;

in the second case, phraseological units including certain words can be motivated, although literal meanings of the words are conditioned" (Ullmann 1970: 254-255).

Many terminologists (Gajda 1990, Kaulakienė 2014, Gaivenytė 2000, etc.) regard all terminologized words that have been turned into terms due to semantic transfer as motivated ones. The third type of motivation is called semantic motivation. It is based on the co-existence of direct and figurative meanings of the same word within the same synchronous system. *Mouth* continues to denote a part of the human face, and at the same time it can metaphorically apply to any opening or outlet: the mouth of a river, of a cave, of a furnace. *Jacket* is a short coat and also a protective cover for a book, a phonograph record or an electric wire. *Ermine* is not only the name of a small animal, but also of its fur, and the office and rank of an English judge because in England ermine was worn by judges in court. In their direct meaning neither *mouth* nor *ermine* is motivated.

Most words used in any language usually change semantically. "The meaning of the word varies due to certain ways of communication (metaphors, metonymy, etc.) that allow the already existing potential of utterances to be used for new purposes" (Fritz 1998: 42). The meanings of words are constantly expanding, narrowing, or being transferred from one conceptual sphere to another, or acquire certain stylistic nuances (Rudaitienė 2014: 114). Under conditions of technological progress, the language constantly eliminates new words to name new concepts, most of which are terms in one or another field. As science and technology are developing rapidly, terminologists may sometimes struggle to coin new terms for naming new concepts fast. Creation of new terms is a complex process, thus, terminization becomes one of the main terminology sources: commonly used words are transferred to a specific scientific field and become terms, or some already existing terms are transferred from one field to another. According to S. Keinys (2005: 231), this practice is convenient, and such terms can be easily used for creation of new terms. This also indicates that creation of neologisms is not always necessary if common language words can be taken as terms.

Therefore, terminization is a process in which the common language words are turned into terms, acquiring terminological meaning. While terminologizing ready-made words, it is important to adhere to a specific principle: the terminological meaning cannot be in conflict with the lexical meaning of the word. Failure to stick to this principle leads to formation of misleading terms (Gaivenis 2002: 51). Terminization is usually related to semantic modification and definition of a word. Generally, terms are created by extending or narrowing a specific meaning of the word, less often – by means of metaphorical expansion or meaning correction. Such words in terminology refer to concepts of specific fields, and definitions reveal the content of the concepts.

Science integration and synthesis have stimulated the adoption of terms from one domain to another (Keinys 2005: 232). A term from one subject area can often be transferred to another by transterminisation. For example, *šaka* in LT (*branch* in EN) in the wood industry is *an outgrowth of a tree trunk, a separate component of its branched stem*; in communication, the "network link or the line connecting two adjacent nodes and without intermediate nodes" (Term Bank of the Republic of Lithuania, TB). If the term has been based on the common language word, without knowing its etymology, it is often difficult to determine whether it has emerged by the way of terminization or transterminization (i.e., by secondary or even tertiary nomination) (Celiešienė 2016: 47).

Terminological nomination is secondary to general nomination (Gaivenytė 2000: 19). According to Paura (2014: 30), secondary nomination occurs when common language

words are given special meanings in a particular field of science by directly terminologizing them. Tertiary nomination occurs when terms are transferred to a specific field from other subject areas by internal borrowing (transterminization).

Common language words that have been turned into terms and have acquired additional meanings on the basis of specific meanings can be regarded as semantic formations. The words which acquire new meanings are referred to as semantic neologisms in linguistics. A new meaning of the newly made term shares common semes with the meaning of the common word, which have motivated the new term" meaning (Gedrimas 2003: 122). In this case, according to Jakaitienė (1988: 92-93), both the source of formation and the result of formation coincide formally, i.e., there is no formal difference between the "source, underlying? word and the newly formed word. In other words, the result of this process is acquisition of a new meaning by the same word, for example:

(1) a. sememe ***leaf 1***: *one of the flat, usually green parts of a plant that are joined at one end to;*

b. the stem or branch (The Cambridge English Dictionary, CED);

c. sememe ***leaf 2***: *a thin sheet of paper* (CED);

d. sememe ***leaf 3*****:** *an extra part of a table that can be folded away when not being used* (CED).

It should be noted that the term transferred to a new domain acquires a newly defined meaning and in each subject field it exists as a separate semantic unit. Synchronically, the first sememe is motivating, and the rest (***leaf 2, leaf 3***) are motivated. The motivated term is peculiar, for it combines the motivating and motivated concepts. The relationship between such sememes can be explained by semantic motivation, which is determined either by the actual similarity of the objects named, or by associations created by imagination, or by a logical connection between the named objects (Jakaitienė 1988: 92-93).

Therefore, semantic motivation is related to the extension of the central meaning of the word, permitting to account for a number of minor meanings. It is important to mention that in the semantic structure, the motivating sememe is semantically independent because its name is not related to the name of another concept. Meanwhile, the motivated sememes are semantically non-autonomous, since they can be explained by the meaning of the first sememe. For example, the computer term virus, meaning software used to infect a computer (PCmagE), can be easily explained by the medical term virus (EOD), but the reverse is probably unrealistic.

In Lejczyk's (1998) view, as soon as a lexical unit starts functioning as a term, from a terminological point of view, it is important to observe if this secondary terminological meaning can be explained by the primary, non-terminological meaning; it is also important to establish the position of the term within the terminological system. Many terminologists consider the words that have been turned into terms by semantic transfer, to be motivated ones (Danilenko 1977: 63), for example:

(2**)** ***kernel*****:** *the part of a nut that is inside the shell and can be eaten* (CED) [motivating sememe] – *the core of the layered architecture that manages the most basic operations of the operating system and the computer processor* (ETB) [motivated sememe].

In general, it is difficult to determine which term is trans-semanticized, especially when foreign language sememes are expressed by lexemes in a native language. This is when semantic loan-translations appear. The choice of foreign language sememes is determined by similarities and differences between the semantic models of the words in the contacting

languages. The result of the "semantic encounter" is a new meaning of the word, derived from another language; at the same time the structure and pronunciation of this newly developed word are "native" (Kaulakienė 2014: 171), for example: the computer term *mouse* (English "*mouse*", French *souris* "mouse", Lithuanian *pelė* "mouse", Russian *мышь* "mouse"). "Thus, these semantic loan-translations are based on the meaning (semantics) of the source word. Linguists have also referred to them as to "hidden borrowings" in their works" (e.g., Keinys 2005: 245).

A. Kaulakienė (2014) explains the spread of semantic loan-translations in terminology by several reasons: "firstly, terminology constantly changes, and new concepts are emerging. If the use of semantic loan-translations were not considered appropriate, we would have to coin a lot of new linguistic units. Secondly, semantic loan-translations help to systematise separate terminology systems. Thirdly, the majority of semantic loan-translations is the source of new formations of a different nature or the basis of compound terms" (Kaulakienė, 2014: 171).

In addition, it should be emphasized that the meaning is only borrowed if the motivating sememe of the source language and the motivated sememe in the target language have a common semantic element. According to Jakaitienė (2010: 128), the motivating meaning is usually the main meaning of the word, which determines the appearance of additional meanings. For example, the primary meaning of the word ***trap*** (*a device or enclosure designed to catch and hold animals, usually by allowing entry but not exit or by catching a part of the body*; EOD), influenced its secondary meaning: *a container or device used to collect something, or a place where something collects* (EOD).

Because of the universal pattern of thinking and similar experience, many cases of meaning transfer are similar in different languages. The aforementioned semantic tendencies are a universal phenomenon, and, in order to confirm that certain development of meanings is really possible, analogies are sought in modern languages. The aim of this study is to define similarities and differences between semantic models of the words of the contacting languages (Lithuanian and English), influencing the choice of foreign sememes, and to reveal semantic relations of IT terms.

3. Results of the Analysis and Discussion

3.1. Terminization of the common language words in computer lexis

Analysis of the terms chosen for the research shows that both Lithuanian and English computer terminology includes a number of simple terms that have evolved from common language words as a result of shift in the meanings of the common words:

(3) *aklavietė* 'deadlock', *apgaulė* 'hoax', *gija* 'thread', *klostė* 'fold', *kaukė* 'mask', *kirminas* 'worm', *krepšys* 'bag', *langas* 'window', *mazgas* 'node', *medis* 'tree', *netiesa* 'false', *lapas* 'leaf', *šaknis* 'root', *pagalba* 'help', *raktas* 'key', *paveldėjimas* 'inheritance', *pelė* 'mouse', *svečias* 'guest', *šešėlis* 'shadow', *žingsnis* 'step', *žvaigždutė* 'asterisk', etc.

Furthermore, the researchers have determined that some Lithuanian computer terms have English equivalents that are not common English words turned into terms:

(4) Lithuanian term *kilpelė* 'loop' / English terms *at, commercial at*;

(5) Lithuanian term *papildinys* 'addition' English terms *plug-in, plugin*;

(6) Lithuanian term *ąselė* 'handle' English term *tab*.

It seems likely that a large part of computer terminology has originated as a result of tertiary nomination (transterminization) and not secondary nomination (terminization). Most of the analysed terminologized common language words with acquired new meanings in the computer science are also used in other scientific fields as terms:

(7) Lithuanian term ***šaknis /*** English term ***root:***

(7a) biology: *the part of a plant which attaches it to the ground or to a support, typically underground, conveying water and nourishment to the rest of the plant via numerous branches and fibres* (OED);

(7b) linguistics: *a morpheme, not necessarily surviving as a word in itself, from which words have been made by the addition of prefixes or suffixes or by other modification* (OED);

(7c) music: *the fundamental note of a chord* (OED);

(7d) mathematics: *a number or quantity that when multiplied by itself, typically a specified number of times, gives a specified number or quantity* (OED);

(7e) computing: *a user account with full and unrestricted access to a system* (OED).

(8) Lithuanian term ***mazgas /*** English term ***node:***

(8a) technical: *a point in a network or diagram at which lines or pathways intersect or branch* (OED);

(8b) physics and mathematics: *a point at which the amplitude of vibration in a standing wave system is zero* (OED);

(8c) astronomy: *either of the two points at which a planet's orbit intersects the plane of the ecliptic or the celestial equator* (OED);

(8d) botany: *the part of a plant stem from which one or more leaves emerge, often forming a slight swelling* (OED)*;*

(8e) anatomy: *a lymph node or other structure consisting of a small mass of differentiated tissue* (OED)*;*

(8f) computing: *in a communications system, a node is a network junction or connection point. Every terminal, computer, hub and switch is a node* (PCmagE).

It has been noticed that the following Lithuanian and English common language words have been terminologized in more than one subject area:

(9) a. Lithuanian term *kaukė /* English term *mask;*

b. Lithuanian term *krepšys /* English term *bag*;

c. Lithuanian term *šaknis /* English term *root*;

d. Lithuanian term *mazgas /* English term *node*;

e. Lithuanian term *lapas /* English term *leaf*;

f. Lithuanian term *medis /* English term *tree*;

g. Lithuanian term *raktas /* English term *key*;

h. Lithuanian term *židinys /* English term *focus*;

i. Lithuanian term *branduolys /* English term *kernel*;

j. Lithuanian term *žingsnis /* English term *step*;

k. Lithuanian term *tinklas /* English term *network* etc.

The cases involving computer terms that entered the computer terminology in both languages as a result of secondary nomination are much less common. For instance, the common language word ***nevykėlis*** (Lithuanian) / ***lamer*** (English), which is defined as *stupid, inept, or dull person (OED)*, has been turned into a computer term as a result of meaning narrowing: *technophobic person or neophyte to computers and technology, as viewed by the technically competent who have little empathy for the novice* (PCmagE).

The examples provided below are computer terms that evolved from common words as a result of secondary nomination:

(10) Lithuanian term ***įsilaužėlis /*** English term ***intruder***: *An attacker that gains, or tries to gain, unauthorized access to a system* (PCmagE);

(11) Lithuanian term ***krūva /*** English term ***heap***: *In programming, it refers to a common pool of memory that is available to the program. The management of the heap is either done by the applications themselves, allocating and deallocating memory as required, or by the operating system or other system program* (PCmagE);

(12) Lithuanian term ***podėlis /*** English term ***cache***: An auxiliary memory from which high-speed retrieval is possible: *[as modifier] 'typical cache sizes range from 64K to 256K'* (OED);

(13) Lithuanian term ***patikėjimas /*** English term ***trust***: *In network directories, a trust is the passing of the rights of one group to another* (PCmagE), etc.

In the analysed sample, the authors of this study have identified several words that have entered Lithuanian computer terminology via tertiary nomination (transterminization) and the English terminology – via secondary nomination, for instance: while TB includes 3 meanings of the Lithuanian term *apgaulė* 'hoax', the same English word *hoax* is only used as a term in the IT area. Other similar examples include the following: Lithuanian term *paveldėjimas* (English *inheritance*) – 5 definitions in TB; Lithuanian *šiukšlės* (English *garbage*) – 4 definitions in TB; Lithuanian *kelias* (English *path*) – 12 definitions in TB.

The results of the study allow the researchers to make an assumption that the tendency to adopt terminology from one scientific area and to introduce it into other scientific areas (the method of transterminization) is characteristic of both English and Lithuanian. Such adopted terms acquire new specific meanings and become new separate semantic units.

3.2. *Semantic motivation of digital terms*

Main Lithuanian simple terms, belonging to the field of information technologies, analysed in this section, may be regarded as common language words that have been turned into terms in the process of terminologization. When comparing them with the English words denoting the same concepts, it can be noticed that some of the concepts and their definitions have likely been borrowed from English as well, for as we know, the USA had been a pioneer in development of computer technology as well as coining computer terminology. Therefore, many Lithuanian terms related to the field of information technologies can be considered semantic loan-translations.

Further on we provide some examples of Lithuanian semantic loan-translations and their English equivalents:

(14) LT word ***Aklavietė*** (en.'deadlock') – general meaning: *Situation with no exit, feeling stuck* (DLKŽ). Definition of term - *In operating systems and database applications, a situation in which two or more processes cannot continue because each process is waiting for resources to be freed by the continuation of the other process* (ETB); EN word ***Deadlock*** – general meaning: *A situation, typically one involving opposing parties, in which no progress can be made* (OED);

(15) ***Kirminas*** (en. 'worm') - general meaning: *an elongated creeping or swimming invertebrate* (DLKŽ). Definition of term – *Self-propagating malicious code that can automatically distribute itself from one computer to another through network connections*

(ETB); EN word ***Worm*** – general meaning: *Any of a number of creeping or burrowing invertebrate animals with long, slender soft bodies and no limbs* (OED);

(16) ***Langas*** (en. 'window') – general meaning: *a space in the wall which has glass in it so that light can come in* (DLKŽ). Definition of term – *a viewing area on screen that contains a surrounding frame (border). It is used to separate parts of an application from each other and to separate one application from another* (PCmagE). EN word ***Window*** – general meaning: *An opening in the wall or roof of a building or vehicle, fitted with glass in a frame to admit light or air and allow people to see out* (OED);

(17) ***Lapas*** (en. 'leaf') – general meaning: *a flattened structure attached to a stem of a plant, the life-giving part of the plant body* (DLKŽ). Definition of term – *in database management, the last node of a tree* (PCmagE). EN word ***Leaf*** – general meaning: *a flattened structure of a higher plant, typically green and blade-like, that is attached to a stem directly or via a stalk* (OED).

As it can be seen from the examples, though translation loanwords are based on 'borrowed' motivation, in many cases they are sufficiently motivated in the Lithuanian language as well, for their terminological meanings can be explained by their non-terminological meanings. As A. Kaulakienė (2014: 233) has noticed, one can identify specific points of semantic intersection between semantically motivated words of contacting languages: central meanings of such words are close. For example, the concept of *inheritance* in Lithuanian, expressed by words *palikimas* (English *legacy, heritage, devise*) and *paveldėjimas* (English *inheritance, heredity, succession*) is close to the meaning of *inheritance* in English. The observation that such "intersection points" exist (i. e., the central meanings are close), enabled terminologists to coin a new computer term *inheritance*, describing a computer-related concept:

(18) Lithuanian *paveldėjimas* 'inheritance' – *naujų objektinio programavimo klasių kūrimas iš turimų; nauja klasė paveldi visas turimos klasės savybes ir gali turėti savų* (EKŽ): 'a new class inherits all the features from the available class and can include its own features';

(19) cf. English *inheritance – In object technology, the ability of a class of objects to inherit properties from a higher class* (PCmagE).

Another example is the Lithuanian word *svečias* (English *guest*), with the central meaning *draugiškas namų lankytojas arba pašalinis asmuo, pakviestas į kokį posėdį, susirinkimą* (DLKŽ): 'a friendly guest visiting the house or an outsider invited to the meeting'. It is close to the central meaning of the English word *guest*: *a person who is invited to visit someone's home or attend a particular social event* (OED). The observation that the central meanings of the words in both languages are close enabled IT specialists and terminologists to coin a new computer term *svečias* 'guest':

(20) Lithuanian *svečias* 'guest' – *neturintis paskyros (neužsiregistravęs) kompiuterinės sistemos naudotojas, kuris naudojasi tam tikromis svečio teisėmis* (EKŽ): 'an unregistered user of the computer system who does not have a personal account, but is given specific guest rights';

(21) cf. English *guest – a person who logs into a network or service that does not have a user account. Guests are given a default set of privileges until they officially register with the service* (ETB).

Just a few units of simple computer terms with new meanings derived from Lithuanian have been identified in Encyclopaedic Dictionary of Computer Terms (EKŽ;

the bilingual LT-EN, EN-LT online dictionary). These units can most likely be considered Lithuanian semantic formations, for example:

(22) Lithuanian term *ąselė* 'handle' (English term *tab) – a prominent part of the card which opens the card when clicked* (EKŽ);

(23) Lithuanian term *kilpelė/ ženklas eta* 'loop' (English terms *at, commercial at*) – *the sign @, used to separate the email address of the subscriber's name from the rest of the address. Code: 64 (ASCII, decimal), 40 (ASCII, hexadecimal)* (EKŽ);

(24) Lithuanian term *papildinys* 'addition' (English term *plug-in, plugin*) – *an additional component embedded in the program, a computer or its gadget, which extends its capability* (EKŽ);

(25) Lithuanian term *svetainė* 'parlour' (English term *website*) – *a set of web pages on a common topic, associated with a specific entity, or providing information on other related matters* (EKŽ);

(26) Lithuanian term *taškas* 'dot' (English term *pixel*) – *the smallest element in pixel graphics* (EKŽ), etc.

The analysis of selected examples has revealed that the majority of Lithuanian computer terms can be considered semantic loan-translations, rendering which requires projecting the semantics of foreign units onto Lithuanian words. Therefore, it can be stated that a major part of Lithuanian computer terms has been adopted from English and has not been created by Lithuanians.

4. Conclusion

Semantic motivation is related to the extension of the central meaning of the word, permitting it to include new referents (objects or ideas to which the word refers). It has been established that the meaning is only borrowed if the motivating sememe of the source language and the motivated sememe in the target language have a common semantic element. In the majority of cases, the central meaning of the word is the motivating meaning, determining the development of coexisting meanings.

Many cases of meaning transfer are similar in different languages due to universal patterns of thinking and similar experience. The semantic tendencies described in this article are considered a universal phenomenon, and, in order to confirm that certain development of meanings is realistic, analogies are sought in modern languages. The aim of the present study has been to reveal similarities and differences between semantic models of the words of the contacting languages (Lithuanian and English), influencing the choice of foreign sememes, and to reveal semantic relations of IT terms.

Various associations come into play in the process of nomination. As the thought processes of people speaking different languages are similar, it is not surprising that phenomena get similar designations in the areas of specialized lexis; the vocabulary related to the field of information technologies (IT) is not an exception. The analysis of selected terms has revealed that terminology related to the field of IT, both in Lithuanian and in English, includes many simple terms that have evolved from specific common language words, as a result of shifts in their meanings. In addition, it has been found that the majority of computer terms, in both languages, have been adopted from other subject areas, in the process of "internal borrowing" (transterminization). Such terms acquire new special semes, enabling linguists to establish the position of the concept within the

terminological system and to define the concept as a separate semantic unit. Furthermore, the research has revealed that a smaller part of the terms have entered the IT vocabulary when special terminological meanings have been assigned to common language words (the method of secondary nomination).

The majority of the analysed words that have entered the Lithuanian IT vocabulary as a result of terminization and transterminization processes can be considered semantic loan-translations, having acquired new meanings from foreign (usually English) words, and based on "borrowed" motivation. Nonetheless, many such words can also be substantiated in Lithuanian, for their terminological meanings can be explained by central, nonterminological meanings. Thus, in the majority of cases, close associations between central meanings of specific English and Lithuanian words have stimulated the development of new terminological meanings related to information technologies. By contrast, only a relatively small number of the analysed Lithuanian terms can be considered semantic formations, having acquired their terminological meanings in the process of turning Lithuanian common language words into terms.

The analysis of IT terms and their definitions has yielded the following insight: both English and Lithuanian common words are frequently turned into terms carrying specific meanings. The study focusing on the spread of semantic formations and semantic loan-translations in computer terminology has enabled the researchers to trace a noteworthy pattern in the development of vocabulary, i.e., shifts occurring in the meanings of words. Such words turned into IT terms denote the concepts related to this specific field, and their content is revealed by definitions of their terminological meanings.

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WEBQUEST AS TECHNOLOGY OF DIFFERENTIATED ESP INSTRUCTION AT UNIVERSITY LEVEL

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Abstract. *The current study aims to find out teachers' attitudes to the WebQuest learning and analyze the specifics of WebQuests and possibilities of their use in differentiated ESP instruction of information technology (IT) students. A qualitative type of research was used. The participants of the study were 31 ESP teachers (28 females and 3 males) of the Department of English for Engineering of National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". The ESP teachers participated in the study voluntarily in 2019-2020. An anonymous questionnaire was used to collect the data. The questioning of the ESP teachers has shown that most of them appreciate the idea of using the WebQuest learning. The analysis of the WebQuest specifics allowed suggesting a classification of WebQuests based on ten criteria. The structure of a WebQuest is described with a focus on IT students' language learning styles and foreign language proficiency levels. Approaches to the WebQuest learning used by ESP teachers in the differentiated instruction were analyzed. It was concluded that the use of different types of WebQuests with a focus on learners' differentiation helps to diversify ESP learning at technical university and facilitates the development of professional communicative skills.*

Key words: *differentiated instruction, WebQuest, IT students, English for Specific Purposes*

1. INTRODUCTION

With rapidly developing information technologies (IT) throughout the world, technical universities are searching for new and effective ways of training highly qualified and competitive specialists with substantial professional knowledge and skills, ready to work at modern labour markets. To meet the contemporary professional standards and requirements, IT students have to be able to communicate in foreign languages at a level sufficient for addressing communication issues in the IT sector. In Ukrainian realities, new global demands dictate changes in English for Specific Purposes (ESP) learning and teaching.

An effective way to promote positive changes in the ESP teaching is to take into account the learners' differentiation (in English language proficiency levels and language learning styles) as well as to use appropriate digital tools in the learning process. With a wide range of current Internet resources for the differentiated ESP instruction, WebQuest technology deserves particular attention due to these features:

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- it gives an opportunity to meet the needs of IT students with different learning styles and foreign language proficiency levels;
- it allows students to practise foreign communicative skills (listening, speaking, reading, and writing) in simulated professionally oriented situations;
- it fosters the increase in the range of professional knowledge;
- it helps organize classroom and extracurricular activities in a flexible way.

1.1. WebQuest CONCEPT

As a multidimensional concept, a WebQuest is interpreted in different ways. For example, Abbit and Ophus (2008) define it as an instructional strategy, Halat (2010) – as a teaching tool and technique for internet-based learning. It is also viewed as "a teacher-created lesson plan in the form of a simple World Wide Web page with active, preselected Internet links and a specific purpose for students" (Kelly 2000, p. 4). The definitions of Dodge (1995) and Brooks-Young (2006) are focused on the WebQuest as an "activity". According to Dodge (1995), it is "an inquiry oriented activity in which some or all of the information that learners interact with comes from resources on the Internet" (Dodge 1995, p. 10). Similarly, Brooks-Young (2006) defines the WebQuest as "an activity based on the inquiry instructional approach where most or all of the information used by students is Internet-based" (p. 61). This gives ground to believe that a WebQuest is not only a web-based learning technology, but also a process and a strategy used by the teacher for guiding students in their problem solving activity.

1.2. Literature review

A whole number of recent publications are devoted to WebQuest and possibilities of its use in the learning process. They highlight the appropriateness of this technology for various categories of learners and a wide range of curriculum disciplines. At secondary school level AL-Khataybeh and AL-Awasa (2016, 112) investigated the effect of using a WebQuest on improving seventh grade female learners' writing skills. MacGregor and Lou (2004) researched its possibilities for providing instructional scaffolding to students. Their findings particularly indicated that "the concept map template was effective in guiding students' synthesizing and organizing the information they gathered for their target purpose and audience" (MacGregor, & Lou 2004, p. 172). The results obtained by Renau and Pesudo (2016, 26) showed that the use of WebQuests motivated students to study English, helped to improve their digital and cultural competences. At university level, a WebQuest became an instrument for developing language receptive and productive skills. For example, Tuan (2011) examined the possibilities of a WebQuest for enhancing the intensive and extensive reading skills when using the constructivist approach, inquiry-based learning approach, project-based approach, and content-based language learning (2011, 666-667). He also found that the students had positive attitude towards the WebQuest-based teaching of reading. Berezova, Mudra and Yakushko (2018) used a WebQuest to improve writing and reading skills. Diachkova (2015) found WebQuests effective for the development of speaking skills of future lawyers at university. Pérez (2016) explored WebQuests in the context of blended and cooperative learning. The analysis of these works shows that different aspects of WebQuest use in foreign language teaching have been studied quite thoroughly. However, the functionality of this tool in differentiated ESP instruction may need further research.

2. The Aim of the Current Study

Thus, the aim of this study is:
1) to find out ESP teachers' attitudes to WebQuest learning at university;
2) to analyze the specifics of WebQuests and possibilities of their use in differentiated ESP instruction.

3. Methods

3.1. Research design

The current study used the qualitative research method focused on collecting information about teachers' attitude to the WebQuest learning, analyzing the teachers' experience and gathered data for defining the specifics of WebQuests and possibilities to use them in the differentiated ESP instruction.

3.2. Research participants

The participants of the study were 31 teachers (28 females and 3 males) of the Department of English for Engineering of National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". The teachers who volunteered in the current study taught ESP to technical students. This research took place in 2019-2020.

3.3. Research instruments and procedures

Initially, the observation of some teachers was conducted during the WebQuest learning. Then, an anonymous questionnaire was used. This questionnaire contained 10 questions with variants of answers which could be chosen by the respondents. The time needed to complete the questionnaire was about 7-10 minutes. The questions were as follows:

1. Would you like to use the WebQuest learning instead of traditional ESP classes?
   a) Yes, fully
   b) Yes, partially
   c) No
2. I use the WebQuest learning because:
   a) it helps to develop students' foreign language communication skills
   b) it facilitates the acquisition of professional knowledge by students
   c) it promotes students' critical thinking, collaborative, self-directed learning skills
   d) all the above mentioned
3. In the WebQuest learning I would like to take/have taken into consideration the learners' differentiation (in language learning styles, English proficiency levels):
   a) In all tasks
   b) In several tasks
   c) In one task
   d) In no tasks

4. In my opinion, learners' _____ autonomy should be provided in the WebQuest learning.
   a) full (the students perform the tasks without the teacher's help)
   b) partial (the students perform the tasks with the teacher's help)
   c) full and partial

5. Where can a WebQuest be used?
   a) in classroom
   b) out of classroom
   c) in and out of classroom

6. What types of assessment are appropriate for the WebQuest learning of technical students? More than one answer can be chosen.
   a) formative assessment
   b) summative assessment
   c) both formative and summative assessment

7. The most acceptable duration of a WebQuest for technical students is _____.
   a) one-two weeks (short-term WebQuest)
   b) one-two months (medium-term WebQuest)
   c) one semester (long-term WebQuest)
   d) all of the above

8. According to the criterion of the "number of performers", it is most appropriate to organize WebQuests as _____ activity. More than one answer can be chosen.
   a) individual
   b) pair
   c) small group
   d) whole academic group

9. It is better to focus on WebQuests that involve _____.
   a) discrete skills (listening, speaking, reading or writing)
   b) integrated skills (for example, reading and writing, speaking and writing etc.)

10. It is better to use _____ in the WebQuest learning.
    a) separated tasks (creative product task, persuasion task, analytical task, self-knowledge task etc.)
    b) combined tasks

3.4. Data Analysis

The process of data analysis involved three stages. First of all, the WebQuest learning was used by the ESP teachers in the learning process for defining its specifics. Then, a questionnaire was used to find out the teachers' attitudes to the WebQuest learning and the data obtained were processed. Finally, the results were interpreted and the conclusions were made.

4. RESULTS

Survey of 31 ESP teachers has shown that most of them (87.09%) appreciate the idea of using the WebQuest learning and would like to replace traditional learning by the WebQuest learning partially, 9.68% of teachers would like to substitute traditional learning by the WebQuest learning completely. And only a small percentage (3.23%) of teachers does not consider it necessary to use this technology.

Most teachers (48.38%) think that there are several reasons to use WebQuests in ESP learning. Among them are possibilities of WebQuests for the development of foreign language communication skills; acquisition of professional knowledge; promotion of critical thinking, development of collaborative, self-directed learning skills. Almost half of the teachers (41.94%) believe that such skills as critical thinking, collaboration, and self-direction, are the basis for lifelong learning.

In all teachers' (100%) opinion, learners' differentiation (in language learning styles, English proficiency levels) must be considered. Most of them (83.87%) think that only certain tasks should be differentiated. Some teachers (5%) believe that differentiation of learners should be considered in all tasks, since it allows meeting the needs and interests of students most fully. However, differentiation in learning requires a lot of teachers' efforts to create tasks for different students.

Teachers' viewpoints on learners' autonomy are quite diverse. During the WebQuest learning some teachers (16.13%) preferred giving IT students the full autonomy, which is proper for those of them who have a high level of English language proficiency (B2) and can solve problems independently without teacher's help. Almost half of the teachers (48.38%) prefer giving students partial autonomy, since the majority of them can fulfil tasks only with the help of the teacher. More than one third (35.48%) of the teachers chose using both types of autonomy (full and partial), because they believe that varying the levels of autonomy is important in differentiated ESP instruction.

Since IT students have only one class (90 minutes long) per week, WebQuests can be used both in and out of classroom. Very few teachers prefer using them only in classroom or only out of classroom (3.23% and 6.45%, respectively). The majority of teachers (90.32%) is sure that a WebQuest can be done both in classroom and out of it.

The results of our research show that preference was given to the summative assessment (by 41.94% of teachers). About a quarter (25.80%) of teachers chose formative assessment. More than one third of the teachers (32.26%) used both kinds of assessment, which in our opinion, seems quite sound.

The duration of the WebQuest learning in each case is determined by the specifics of a particular ESP course. We defined the following types of WebQuests: short-term (one-two weeks), medium-term (one-two months), and long-term (one semester). More than half of the ESP teachers (58.06%) preferred medium-term WebQuests, about a quarter of them (25.80%) mostly used short-term WebQuests, some teachers (6.45%) choose rather long-term WebQuests. Also, 9.68% of ESP teachers could use WebQuest of different duration. We can say that the choice of such types of WebQuests correlated with the aims of the educational process.

The teachers' views on the most appropriate number of performers of WebQuests are diverse. The most acceptable (chosen by 45.16% of teachers) format of organization of WebQuests was a small group, because any problem can be solved better if the learners can express their thoughts, share their opinions and find common solutions. Almost all ESP teachers (93.55%) tend to focus more on WebQuests to develop integrated rather than discrete skills.

5. DISCUSSION

5.1. Classification of WebQuests used for IT students

Dodge (1997; 1999) suggested a taxonomy of tasks (retelling, compilation, creative, scientific, persuasion, analytical, consensus, self-knowledge, journalistic, designing, judgment, mystery tasks) and distinguished short-term and long-term WebQuests. Taking into account the results of his study, as also the experience of teaching ESP to IT students at technical universities, we have classified WebQuests according to the following criteria: duration of WebQuest, number of performers, type of WebQuest tasks, types of language learning skills to be developed, a possibility to differentiate tasks, a place where a WebQuest is performed, type of the final product, level of learners' autonomy, type of assessment, type of learning content (Table 1).

Table 1 WebQuest classification

Criteria for WebQuest	Types of WebQuests
1. Duration of WebQuest	▪ one-two weeks (short-term WebQuest) ▪ one-two months (medium-term WebQuest) ▪ one semester (long-term WebQuest)
2. Number of performers	▪ one individual ▪ a pair ▪ a small group ▪ a whole academic group
3. Type of WebQuest tasks	▪ separate tasks (retelling tasks, compilation tasks, creative product tasks, scientific tasks, persuasion tasks, analytical tasks, consensus building tasks, self-knowledge tasks, journalistic tasks, designing tasks, judgment tasks) ▪ combined tasks
4. Types of language learning skills to be developed	▪ discrete skills (listening, speaking, reading, writing) ▪ integrated skills (for example, writing and reading)
5. Possibility to differentiate the tasks	▪ differentiated (according to learning styles and / or English proficiency levels) tasks ▪ non-differentiated tasks
6. Place where a WebQuest is performed	▪ in classroom ▪ out of classroom ▪ both
7. Type of a final product	▪ oral ▪ written ▪ combined
8. Level of learners' autonomy	▪ full ▪ partial ▪ both full and partial
9. Type of assessment	▪ formative ▪ summative ▪ both formative and summative
10. Content type	▪ professionally oriented

5.2. WebQuest structure used in the differentiated ESP instruction

The structure of the WebQuest is important since it provides an algorithm which helps the teacher to guide the students through their research activity. According to Dodge (1997), the WebQuest includes the following stages: introduction, task, process, resources, evaluation, conclusion. We considered them in the context of the differentiated ESP instruction.

The *introduction* stage aims at outlining the context of the WebQuest topic, showing its relevance for IT students.

The *task* stage focuses on a communicative situation which is to be realized.

The *process* stage determines the steps the students should take in order to solve a problem. At this stage, IT students can be differentiated according to their dominant language learning style (Synekop, 2018). For example, students with the dominant visual modality use scaffolding like tables or diagrams. The students with the dominant auditory modality are suggested activities in which they interact with each other, discuss the problems. The students with the dominant kinesthetic modality can conduct a survey and use such scaffolding as cards. Also at this stage, differentiated activities can also be suggested according to the English proficiency level.

The *resources* stage offers a list of Internet-resources that help IT students to solve the problem. The Internet-resources can also be differentiated according to the complexity level.

The *evaluation* stage suggests different scales with criteria for assessment of the final product such as a discussion assessment scale, writing assessment scale, group self-assessment checklist. The final product of the students with various English proficiency levels is evaluated in different ways: the IT students who perform complicated tasks get higher grades and the IT students who perform less complicated tasks get lower grades.

The *conclusion* stage implies IT students' summarizing their achievements and reflecting on them, which may inspire them to continue studying the topic.

5.3. Approaches to WebQuest learning used by ESP teachers in the differentiated instruction

Based on the experience of participants of our study, we singled out the main approaches to WebQuest learning which were used in differentiated ESP instruction: student-centered, experiential, reflective and collaborative approaches.

Student-centered approach helped to focus on an active learner with an emphasis on his/her professional interests, needs, and experience in ESP learning. Additionally, different language learning styles and English proficiency levels of learners who followed their own trajectories at their own individual pace were taken into account. This helped to create favorable learning environment in which the learner was motivated and responsible for the learning outcomes. Using WebQuest as technique in the teaching and learning process allowed ESP teachers to differentiate tasks according to various learners' language learning styles and English proficiency levels. IT students could make a choice about what to do and how.

Experiential approach is based on "a holistic integrative perspective on learning that combines experience, perception, cognition, and behavior" (Kolb 2015, p. 31). On the one hand, the effectiveness of learning depends on learners' ability to perceive and process information, learners' motivation and self-regulation. On the other hand, learning efficacy

relies on learners' participation in learning activities through which they gain foreign language and professional experience. Thus, learner's professional communicative knowledge and skills are constructed or shaped through upgrading their experience. It, in turn, leads to the development of communicative competence. Using WebQuest as a role play gave students an opportunity to immerse in role-playing and practise their English communication skills in the IT field, as well as extend their professional knowledge.

Reflective approach was also incorporated into the learning process with the use of the WebQuest tool. Reflection is an inseparable part of experiential approach because it "turns experience into learning" (Boud, Keogh and Walker, 1985) and development. It implies the learner's ability to realise, analyze and rethink the experience in order to compare his/her achievements with their level of knowledge and skills development at the initial stage of ESP learning. All the stages of creating a WebQuest, starting with the introduction stage, when the students should understand the problem, and ending with the conclusion stage, when they summarize their results, imply the development of reflective skills.

Collaborative approach "strongly correlates with the provisions of experiential approach and promotes the development of students' interpersonal skills and abilities to serve as a team member" (Korol 2019, p. 118). The learners in homogeneous or heterogeneous groups actively participated in solving the problem of WebQuest and creating the final product. They worked interactively while searching for information, generating ideas, discussing problems, commenting suggestions and evaluating the outcomes.

6. Limitations

The current study was focused on defining the specifics of using WebQuests in differentiated ESP instruction at technical university and determining the attitudes of ESP teachers to the use of this technology. The research was limited to Ukrainian participants only (31 teachers); however, similar surveys can be conducted on the data sets of different countries to receive new insights. Additionally, the quantitative research design can be used to determine the effectiveness of WebQuest technology in differentiated ESP instruction.

7. Conclusion

Our study shows that ESP teachers have positive attitudes to the use of the WebQuest learning and the flexibility of this technology permits using it in the differentiated ESP instruction. The analysis of WebQuest specifics allowed us to suggest a WebQuest classification based on ten criteria. Also, the structure of the WebQuest was focused on differentiation of IT students according to the language learning style and foreign language proficiency level. The use of student-centered, experiential, reflective and collaborative learning approaches helped the teachers to organize and guide differentiated WebQuest activities. The conclusion was made that the use of various types of WebQuests with focus on learners' differentiation not only helps to diversify the ESP learning at technical university, but also facilitates the development of professional communicative skills.

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