

Development of Structure of the Users' Motivational Intentions Database of the Web-Community for Supply and Demand of Educational Services and Evaluation of Its Information Content Quality

Anna Shilinh

Lviv Polytechnic National University, S. Bandery st. 12, Lviv, 79000, Ukraine

Abstract

The aim of this article is to develop the structure of the users' motivational intentions database of the web community for supply and demand of educational services and evaluation the quality of its information content. This makes it possible to effectively communicate and satisfaction the needs of users who are looking for a necessary training course or offer their services in acquiring the necessary knowledge, skills and abilities. The article establishes that the keywords of thematic posts that define the relevant thematic sections of the web community for supply and demand of educational services coincide with the motivational intentions of its users. In accordance with this, the structure of the database includes such relations as "Indication MI", "Motivational Intentions", "EduSection", "Keywords". The development of an indicator of the importance of keywords in thematic posts of specialized community's users, which evaluates the keywords in the post and reduces the importance of commonly used words, is the task of this paper. The article establishes that the content of the users' motivational intentions database is an information product. That is why the paper applies metrics according to the ISO/IEC-25010 standard to evaluate the quality of the information content of the users' motivational intentions database of the web community for supply and demand of educational services. The analysis of metrics that correspond to the characteristics/sub-characteristics of software quality according to the ISO/IEC-25010 standard shows that such characteristics/sub-characteristics as Functional suitability (Accuracy) and Operability (Helpfulness) are suitable for evaluating the quality of information content of the web community for supply and demand of educational services. The article contains an analysis of the quality of information content of the specialized web community for supply and demand according to the proposed metrics. The results of the study are used and can be used for effective moderation of specialized web communities for supply and demand of educational services, as well as facilitate communication between their participants.

Keywords

Database, motivational intentions, user needs, ISO/IEC-25010 standard, supply and demand of educational services, web community.

1. Introduction

A specialized web community is a convenient and effective tool for attracting users with common interests and needs, including educational ones. The challenges of the modern world, such as Covid-19 and russia's full-scale invasion of Ukraine, have forced a significant part of society's educational activities to move into the virtual space. Public educational institutions of all accreditation levels form

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EMAIL: anna.y.shilinh@lpnu.ua (A. Shilinh)

ORCID: 0000-0003-1063-3437 (A. Shilinh)



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the main offer of educational services. However, these educational institutions cannot provide the acquisition of specific skills at a certain point in time, as their process is clearly set up, calculated and cannot be changed at any time during the school year, nor can it be adapted to the specific needs of its students.

An analysis of Internet users' search queries on <https://trends.google.com.ua/> in 2022-2023 (Figure 1) shows that, along with the item "educational services," the item "training courses" has become very popular.

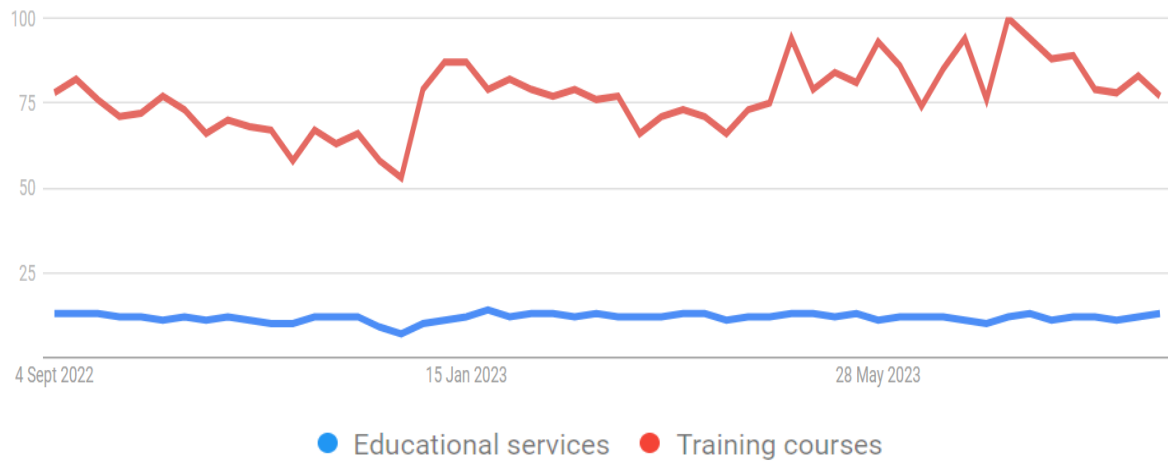


Figure 1: Interest in the search items as "educational services" and "training courses" over time according to Google Trends

In particular, the global average indicator of these search queries for 2023 (Figure 2) also shows a significant excess of interest among users of the virtual space in obtaining additional knowledge and skills.

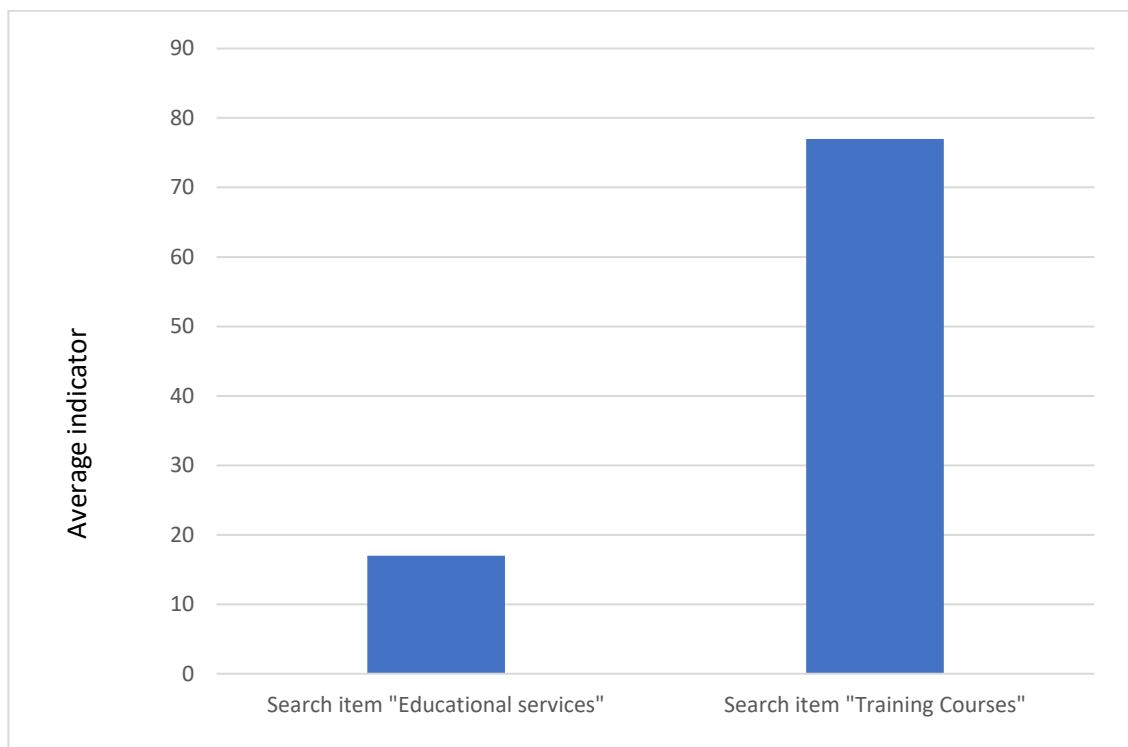


Figure 2: Average indicator of search rate for the items "educational services" and "training courses" according to Google Trends

That is why specialized virtual communities have gained popularity in the educational services market, where participants can offer their services in the field of education or find the right teacher to help them acquire the knowledge, skills, and abilities they need now. Such cooperation is beneficial for both members of the virtual community. In particular, there is a need to coordinate this cooperation, taking into account the communication, psychological factors and capabilities of both parties to communication through the social environment of the Internet. This determines the relevance of this article.

It is also worth considering that along with a significant number of specialized web communities that are becoming popular among users in terms of obtaining additional knowledge and skills, there is a problem of the quality of information content. The formation of information content that takes into account the users' interests of specialized web communities is an information product. That is why it is advisable to use the approaches that are already known for evaluate the quality of such information products as software to evaluate the quality of their content. Therefore, the analysis of text ads of all members of such specialized web communities and the evaluation of the quality of their information content for effective interaction between members of the web community of supply and demand of educational services is the basis for the structure of this research.

2. Related works

Today, virtual space is the primary source of communication activity, not a medium of passive informatization [1; 2]. That is why a large amount of information content of specialized web communities requires its intellectual processing and analysis of its effectiveness [3-5]. Papers [6, 7] discuss the features of educational web forums. In particular, work [8] analyzes the development of educational web forums.

Methods of data mining and text analysis are discussed in [9]. In particular, papers [10; 11] analyze methods for solving the problem of extracting information from texts. The linguistic foundations of the extraction of terminological units from scientific and technical texts are the subject of study [12]. The structure of specialized vocabulary, lexical representation of the topic of extraction from scientific literature for competence management is the aim of the study [13].

The process of creating targeted information content is analyzed in [14]. In particular, [15] determines the probability of communication between members of target groups and their dependence on the positions of other participants in the virtual social space.

The analysis of communicative interaction on web forums, namely their information behavior and classification of participants, is the subject of research [16-17].

The study [18] contains a linguistic analysis of the information content of a web forum for applicants. An analysis of standards and recommendations for quality assurance in the European Higher Education Area is contained in [19].

In studies [20; 21], methods for determining the meaning of words in the web space are defined and the quality criteria for web pages are defined. The main provisions and metrics for evaluating software according to the ISO/IEC-25010 standard are set forth in documents [22-24]. The use of software quality evaluation methods for information content in the form of web galleries and databases is defined in [25; 26].

However, none of the studies considers the possibility of integrating the extracted users' motivational intentions of the web community for demand and supply of educational services for effective moderation of the web community and communication of its participants.

Analyzing thematic users' posts of the web community for supply and demand of educational services and evaluating its information content requires the identification of keywords that characterize a particular section of the web community and the motivational intentions of users, i.e. words or phrases that identify them and determine their attitude to a particular section of the community. That is why the aim of this article is to develop the structure of the users' motivational intentions database of the web community for supply and demand of educational services and to assess the quality of its information content for effective communication between its members and management of this community. The objective of this paper is to describe the structure of the users' of motivational intentions database of

the web community for supply and demand of educational services, to evaluate the quality of its information content, and to define metrics according to the ISO/IEC-25010 standard.

3. Formation of a users' motivational intentions database of the web community for demand and supply of educational services

Web communities for the supply and demand of educational services are an important space for active communication between users who need additional knowledge, skills, and users who offer them. Posts and announcements published in the respective thematic sections of such specialized web communities require the extraction of keywords that characterize the motivational intentions of their users. This is a direct indicator of the user's interest in these resources and influences the decision-making process in choosing or offering educational services. Formation of a database of users' motivational intentions of the web community for supply and demand of educational services allows creating a comfortable and effective communication process for its participants by analyzing their information needs, which are determined by the relevant motivational intentions.

The basis for creating a users' motivational intentions database of the web community for supply and demand of educational services is a set of keywords of each thematic web community's section. It is based on the decomposition method. This method involves rejecting a part of a post until the part of the post matches the syntactic one.

That is why the process of forming a users' motivational intentions database is based on comparing the elements of a text post or announcement in the web community for supply and demand for educational services with the elements of a set of keywords for each of its thematic sections.

A description of the structure of the users' motivational intentions database of the web community for supply and demand of educational services is presented in Figure 3.

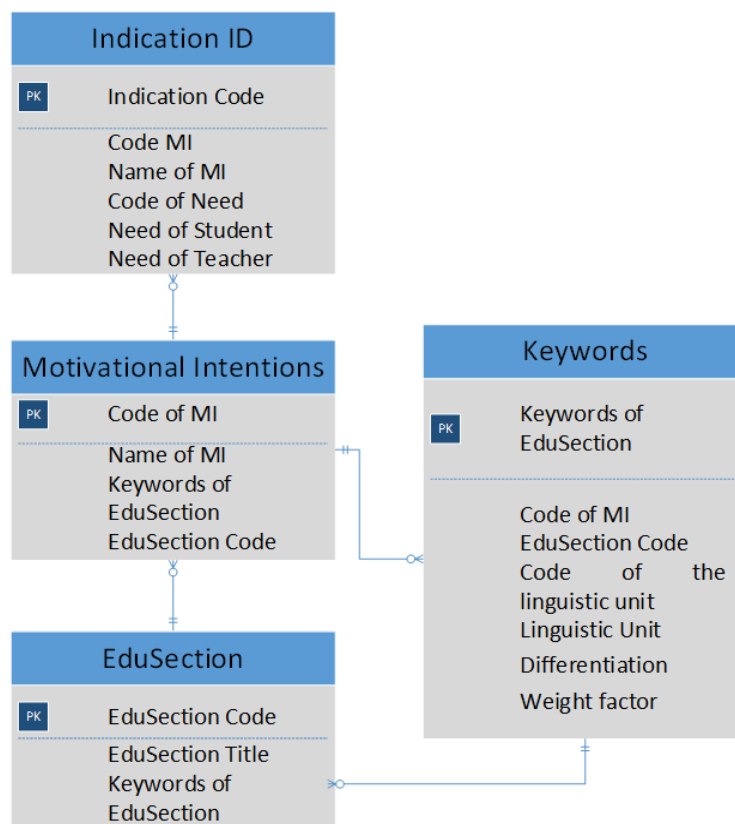


Figure 3: Structures of the users' motivational intentions database of the web community for supply and demand of educational services

The "Motivational intentions" relation contains data on the users' motivational intentions of the web community for demand and supply of educational services that correspond to the keywords (the "Keyword of EduSection" attribute) of a certain thematic section (the "EduSection Code" attribute).

The "Indication MI" relation includes signs of the motivational intentions of users of the web community for demand and supply of educational services based on their needs. As a result, the components of motivational intentions include the attribute "Student's Need" - the needs of the user who needs educational services, and the attribute "Teacher's Need" - the needs of the user who offers educational services. These attributes contain information about the name of the need. As a rule, the wording of these needs can be the same for different types of users, but they have a different impact on the decision-making process and a certain weighting factor. For example, if the motivational intentions of users relate to "acquiring educational knowledge" in a particular subject, then the user's need is to "learn" this subject as a designation of the direct process, and the names of specific skills, etc. as a designation of the information need. It can also indicate the need of a user who intends to provide these services, so his post will have the same keywords. However, the weighting for them is different at a particular moment in time.

The "Keywords" relation contains data on possible forms of lexical and semantic one or more keyword designations that characterize the users' needs of the web-based community for supply and demand of educational services in relation to a particular thematic section. For example, the users' information need of the web community for supply and demand of educational services is the name of this need (obtaining information about training courses, the need to share experiences, etc.) The "Differentiation" attribute shows the possibility of using a specific value of the "Linguistic Unit" attribute to replace the motivational intentions of users of the web community of demand and supply of educational services. Depending on the possibility of differentiation, it takes values in the range [0, 1]. For example, for motivational intentions that denote an information need, the lexical and semantic designations of this need are the names of a course or a specific teacher. The "Weight factor" attribute shows the importance factor of the motivational intentions identified in the information content of a particular section of the web community.

The "EduSection" relation contains data on language constructions that indirectly indicate motivational intentions for a specific section of the web community for supply and demand of educational services. That is, they do not name the section but point to it. The connection between the motivational intentions caused by a specific need of the user of the web community is made through keywords that refer to a particular section of it.

3.1. Evaluation of the keywords importance in the posts of users of the web community for demand and supply of educational services

It is necessary to evaluate the keywords importance in the posts for effectively inform the user of the web community for supply and demand of educational services.

Keywords that characterize the users' motivational intentions regarding a particular section of the web community for supply and demand of educational services determine the relevance of these posts in terms of the completeness of the necessary information. That is why there is a need to evaluate the importance of keywords in the users' posts of these specialized web communities.

A statistical indicator for text analysis and information retrieval was used to assess the importance of the identified keywords in user posts.

The keywords importance of a post in a particular section of the web community for supply and demand of educational services is proportional to the number of occurrences of the word in the post, and inversely proportional to the frequency of the word in other thematic posts in the section of this community:

$$\omega_{pij} = F_{pij} * InF_{pij} , \quad (1)$$

where $F_{pij} = \frac{n_{pij}}{\sum_k n_{pijk}}$ is the ratio of the number of occurrences of the j-th keyword to the total number of words in the i-th thematic post in relation to the p-th section of the web community of supply and demand of educational services, $InF_{pij} = \log \frac{|D|}{|d_{pij} \ni t_{pi}|}$ is the inversion of the frequency with which

the j -th keyword occurs in the i -th thematic post relative to the p -th section of the web community of supply and demand of educational services.

The indicator Fr_{pij} evaluates the importance of the keyword within the selected thematic post. The use of InF_{pij} reduces the weight of commonly used words. Keywords with a high frequency of occurrence within the post and a low frequency of occurrence in other topical posts within the community section will receive a higher weight ω_{pij} . The calculation of the keywords importance in the users' posts of the web community for supply and demand of educational services is presented in Table 1.

Table 1

Calculating the keywords importance in the users' posts of the web community for demand and supply of educational services

Thematic section of the web community	Keyword	F_{pij}	InF_{pij}	ω_{pij}
Tutor	math	0,62	0,725	0,4495
Announcement of students	external independent evaluation	1	0,8	0,8
Online tutor	online platform	0,4	0,8	0,32

Thus, to determine the keywords importance included in the information content of the users' motivational intentions database of the web community for supply and demand of educational services, the indicator ω_{pij} was determined, which determines the importance of the actual keyword within the post in the relevant section of this web community and reduces the importance of commonly used words. Since the effectiveness of communication and informatization of users of the web community for supply and demand of educational services directly depends on the accuracy and quality of the information provided, the assessment of the importance of keywords identified in user posts is a necessary indicator to solve this problem.

4. Evaluating the quality indicators for information content of the users' motivational intentions database of the web community for supply and demand of educational services

The database of motivational intentions revealed in the thematic sections of the web community for supply and demand of educational services is an important tool for the effective functioning of such specialized web communities. That is why it forms an important task for moderators and administrators of this community to monitor the quality of this information and its compliance with standards and specifications.

The content of the web community for supply and demand for educational services is an information product. Therefore, to assess its quality, we used the characteristics/sub-characteristics of software quality according to the ISO/IEC-25010 standard.

The analysis of metrics that correspond to the characteristics/sub-characteristics of software quality according to the ISO/IEC-25010 standard shows that the following characteristics/sub-characteristics are suitable for evaluating the quality of information content of the web community for supply and demand for educational services

1. Functional suitability: Accuracy;
2. Operability: Helpfulness.

4.1. Development of Functional suitability quality indicator for information content of the users' motivational intentions database of the web community for supply and demand of educational services

The requirements for evaluating the quality of the information content of the motivational intentions database satisfy the sub-characteristic of Functional suitability as Accuracy.

Sub-characteristic Accuracy is the degree to which a software product provides correct or specified results.

This quality indicator is defined as follows:

$$Q_{ij}^{(FAccuracy)} = \frac{|Element_{ij}^{(DefKeyword)}|}{T_{ij}^{(FA)}} \rightarrow 1, \quad (2)$$

where $|Element_{ij}^{(DefKeyword)}|$ is the number of elements of the set of detected accurately described keywords in the database content for the i-th motivational intent of the j-th thematic section of the web community, $T_{ij}^{(FA)}$ is the time of the operation for the i-th motivational intent of the j-th thematic section of the web community.

Thus, the Functional suitability (Accuracy) quality indicator shows the level of presence of inaccurate wording of keywords or the absence of keywords that express the i-th motivational intention of the j-th thematic section of the web community in the information content of the database.

4.2. Development of Operability (Helpfulness) quality indicator for information content of the users' motivational intentions database of the web community for supply and demand of educational services

The requirements for evaluating the quality of the information content of the users' motivational intentions database of the web community for supply and demand of educational services satisfy the following sub-characteristic of Operability as Helpfulness.

Helpfulness is a measure of the user's availability of help.

According to the availability of help, Helpfulness is defined as follows:

$$Q_{ij}^{(Help)} = \frac{|Element_{ij}^{(MI)}|}{|Element_{ij}^{(Comment)}|} \rightarrow 1, \quad (3)$$

where $|Element_{ij}^{(MI)}|$ is the number of elements of the keywords set that occur in the posts of users of the web community for supply and demand of educational services regarding the i-th motivational intention of the j-th thematic section of the web community, $|Element_{ij}^{(Comment)}|$ is the number of elements of the keywords set for which there were comments from other users of the web community.

Thus, quality indicator of Operability (Helpfulness) shows the share of useful comments for users that contain motivational intentions in relation to the i-th motivational intention of the j-th thematic section of the web community.

5. Monitoring the results of selected quality indicators for the information content of the users' motivational intentions database of the web community for supply and demand of educational services

The monitoring of information content quality of the users' motivational intentions database of the web community for supply and demand of educational services was carried out on the basis of the choice of quality indicators of information content of these motivational intentions using the relevant web resource BUKI (<https://buki.com.ua/>). The monitoring of the quality indicators of the BUKI web resource information content was carried out according to the following indicators:

- Functional suitability (Accuracy);
- Operability (Helpfulness).

To analyze the dynamics of the quality indicators of the information content of the database was consider the value of the indicator to be optimal if it belongs to the interval $[0.7; 1]$, and acceptable if it belongs to the interval $[0.4; 0.7)$.

The indicators of the quality of the information content of the users' motivational intentions database of the web community for supply and demand of educational services on the example of the BUKI web resource are shown in Figure 4.

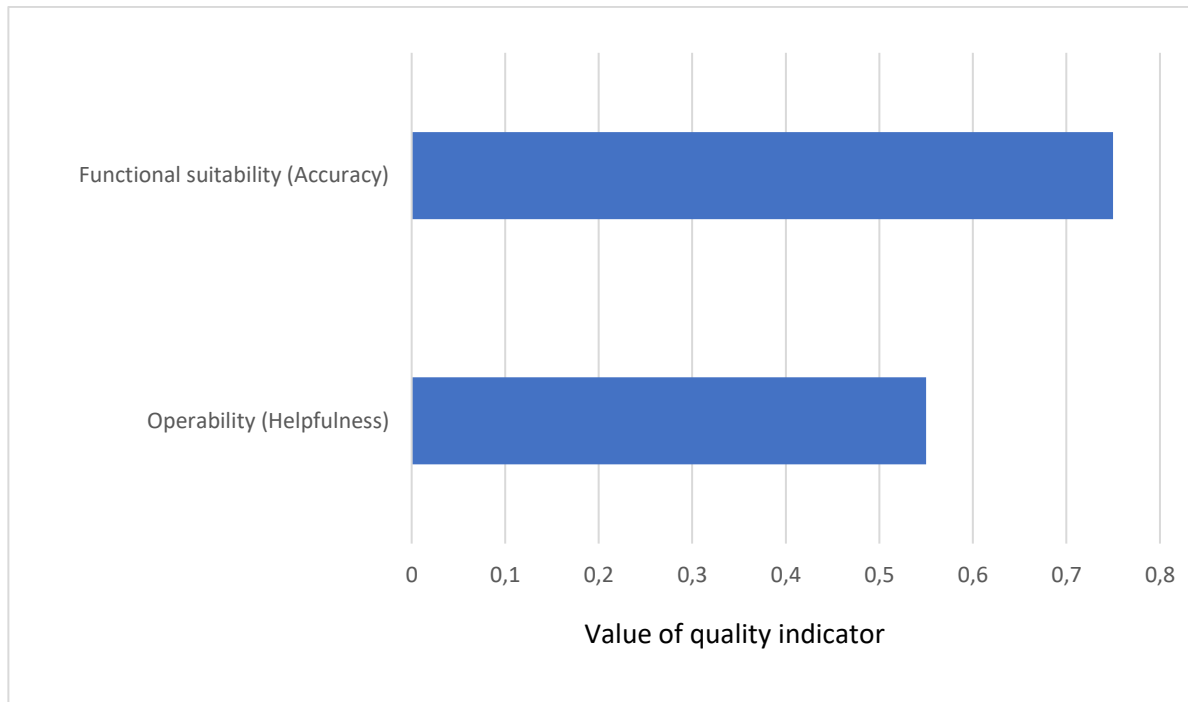


Figure 4: Quality indicators of the information content of the users' motivational intentions database of the web community for supply and demand of educational services on the example of the BUKI web resource

Thus, as can be seen from Figure 4, the Functional suitability (Accuracy) indicator has acquired the optimal value, while the indicator of operability by information content has taken values from the interval of acceptable quality indicators. This is due to the peculiarity of the functioning of this specialized web community for supply and demand of educational services, as well as the existence of competition of such web resources in the virtual space.

The results of the evaluation of the information content quality indicators of the web community for supply and demand of educational services users' motivational intentions database the show the effectiveness of the existing information content within the framework of the functioning of the specialized web community.

6. Conclusions

Thus, the proposed structure of the users' motivational intentions web community for supply and demand of educational services database is aimed at structuring the basic needs of its participants, which is an important condition in the decision-making process. The formation of such a database makes it possible to identify relevant posts and respond in a timely manner to the current needs of supply and demand for educational services identified by its participants. The presence of motivational intentions indicates the specific need of a web community member to receive or offer relevant educational services. This creates the need to determine the importance of the identified keywords in the

participants' posts. That is why the paper proposes an indicator of the importance of keywords in the users' posts of these specialized web communities.

Since its participants are responsible for the web community for supply and demand of educational services formation of the content, the paper proposes to evaluation the quality of information content based on the metrics of the ISO/IEC-25010 25010 standard. The analysis of metrics that relate to the characteristics/sub-characteristics of software quality according to ISO/IEC-25010 shows that the following characteristics/sub-characteristics are suitable for evaluating the web community for supply and demand for educational services information content quality as Functional suitability (Accuracy) and Operability (Helpfulness). The monitoring of the relevant indicators of the quality of information content was carried out by analyzing the content of the specialized web community for supply and demand as BUKI (<https://buki.com.ua/>). The obtained results of the study can be used for effective moderation of specialized web communities and effective communication of its participants.

7. References

- [1] V. Vus, S.Albota, V.Dobrovolska, The analysis of online communities as platforms for informational influences” *Journal of Scientific and Engineering Research* 6(2) (2019) 72-78.
- [2] G. Burnett, Information exchange in virtual communities: a comparative study, *Journal of Computer-Mediated Communication* 9(2) (2006). URL: <http://onlinelibrary.wiley.com/doi/10.1111/j.1083-6101.2004.tb00286.x/full>.
- [3] L. Yi, B. Liu, Eliminating noisy information in web pages for Data Mining, in: *Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery & Data Mining (KDD-2003)*, Washington DC, USA, 2003, pp. 296-305.
- [4] Y. Serov, R. Kravets, A. Peleshchynshyn, Methods of analyzing the effectiveness of Web forums [Metody analizu efektyvnosti veb-forumiv], *Information systems and networks, Herald of Lviv Polytechnic National University* 653 (2009) 197-206. [in Ukrainian]
- [5] A. Oudshoff, I. Bosloper, T. Klos, L. Spaanenburg, Knowledge discovery in virtual community texts: Clusterig virtual communities, *Journal of Intelligent & Fuzzy Systems* 14 (1) (2003) 13-24.
- [6] M. King, *A Strategic Assessment of the Higher Education Industry: Applying the Porter's Five Forces for Industry Analysis*, 2015. URL: <https://studylib.net/doc/8689864/a-strategic-assessment-of-the-higher-education-industry--....>
- [7] A. Alkhathlan, A. Al-Daraiseh, An analytical study of the use of social networks for collaborative learning in higher education, *International Journal of Modern Education and Computer Science (IJMECS)* 9(2) (2017) 1-13.
- [8] Yu. Syerov, S. Fedushko, Z. Loboda. Determination of development scenarios of the educational Web forum, in: *2016 XIth International Scientific and Technical Conference Computer Sciences and Information Technologies (CSIT)*, Lviv, Ukraine, 2016, pp. 73-76, doi: 10.1109/STC-CSIT.2016.7589872.
- [9] A. Santos, P.G. Guillen, E. Villa, F. Serradilla, Semantic construction of univocal language. *Information Theories and Applications* 19(3) (2012) 211-215.
- [10] O. Corcho, M. Lopez, A. Gomez-Perez, Methodologies, tools, and languages for building ontologies. Where is their meeting point?, *Data & Knowledge Engineering* 46 (2003) 41-64.
- [11] P. Buitelaar, P. Cimiano, B. Magnini, Ontology learning from texts: an overview. in *ontology learning from text: methods, evaluation and applications*, *Computational Linguistics* 23 (4) (2005) 234-265.
- [12] E. Simperl, M. Mocho, Achieving maturity: the state of practice in ontology engineering, *International Journal of Computer Science and Applications, Technomathematics Research Foundation* 7(1) (2010) 45-65.
- [13] P. Buileaar, T. Eigner, Topic extraction from scientific literature for competency management, in: *The 7th International Semantic Web Conference PICKME*, Germany, 2008, pp. 55-67.
- [14] A. Meligy, H. Ibrahim, M. Torcky, Identity verification mechanism for detecting fake profiles in online social networks, *International Journal of Computer Networks and Information Security (IJCNIS)* 9(1) (2017) 31-39.

- [15] P. Hoff, A. Raftery, M. Handcock, Latentspace approaches to social network analysis, *Journal of the American Statistical association* 97(460) (2002) 1090-1098.
- [16] O. Tymovchak-Maksymets, A. Peleshchyshyn, K. Sloboda, Analysis of communicative interaction on web forums: information behavior and participants [Analiz komunikatyvnoi vzaємodii na veb-forumakh: informatsiina povedinka ta uchasnyky], *Herald of Lviv Polytechnic National University* 699 (2011) 352-361. [in Ukrainian]
- [17] T. Johnson, B. Kaye, Webelievability: A Path Model Examining How Convenience and Reliance Predict Online Credibility, *Journalism and Mass Communication Quarterly* 79 (2002) 619-642.
- [18] P. Zhezhnych, A. Shilinh, V. Melnyk, Linguistic analysis of user motivations of information content for university entrant's web- forum *International Journal of Computing* 18 (1) (2019) 67-74.
- [19] The European Higher Education Area. Join Declaration of the Ministers of Education, Bologna 1999.
- [20] L. Page, S. Brin, W. Terry, The page rank citation ranking: bringing order to the Web. URL: <http://ilpubs.stanford.edu:8090/422/1/1999-66.pdf>.
- [21] R. Song, H. Liu, J.-R. Wen, W.-Y. Ma, Learning block importance models for Web pages in: *Proceedings of the 13th international conference on World Wide Web*, New York, NY, 2004, pp. 203-211.
- [22] Yu.V. Ryshkovets, Methods and means of building Web galleries taking into account the interests of the user [Metody ta zasoby pobudovy vebhalerei z urakhuvanniam interesiv korystuvacha], PhD thesis, Lviv Polytechnic National University, Lviv, 2013. [in Ukrainian]
- [23] Yu. O. Serov, Methods and means of building effective virtual communities based on Web forums [Metody ta zasoby pobudovy efektyvnykh virtualnykh spilnot na osnovi Veb-forumiv], PhD thesis, Lviv Polytechnic National University, Lviv, 2010. [in Ukrainian]
- [24] Systems and software engineering. Systems and software Quality Requirements and Evaluation (SQuaRE). System and software quality models, ISO/IEC 25010.2:2008. URL: http://sa.inceptum.eu/sites/sa.inceptum.eu/files/Content/ISO_25010.pdf.
- [25] Software engineering. Product quality. Part 1: Quality model ISO/IEC 9126-1:2001. URL: <http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=22749&ICS1=35&ICS2=80&ICS3>.
- [26] Software engineering. Product quality. Part 2: External metrics ISO/IEC TR 9126-2:2003. URL: http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber.