

# Synchronization competencies provided by traditional educational system with real-life required competencies in conditions of digital sociality

Yevhenii B. Shapovalov<sup>1</sup>, Viktor B. Shapovalov<sup>1</sup>, Borys B. Shapovalov<sup>2</sup> and Pavlo D. Antonenko<sup>3</sup>

<sup>1</sup>The National Center "Junior Academy of Sciences of Ukraine", 38-44 Degtyarivska Str., Kyiv, 04119, Ukraine

<sup>2</sup>Kyiv Institute of the National Guard of Ukraine, 7 Oborony Kyieva Str., Kyiv, 03179, Ukraine

<sup>3</sup>College of Education, University of Florida, PO Box 117042, Gainesville, FL 32611-7044, USA

**Abstract.** In terms of development of digital sociality, the role of IT skills is growth for both, IT and non-IT-specialists. However, it is not taken into account in current educational programs. The paper aims to describe the system that will provide corresponding between providing the request by employers and by delivering that request to methodists that developing educational programs. The main actors in the proposed systems are Employer, Job Seeker and Ministry specialist (Methodist). The proposed concept may be realized as well using simple basic tools such as MS Excel and as well by specialized tools such as KIT Polyhedron and as by using Python. In further studies all, MS Excel-, Ontology- and Python-based tools to make concept proof test.

**Keywords:** competencies, educational program, real-life skills, information system, digital sociality

## 1. Introduction

The problem of building digital-based sociality is actual today. However, tendencies of development are very high and education is one of the fields that may not provide required digital-based changes [13, 22]. Especially digitalization has come sharply during COVID-situation and it led to some problems related to its implementation [6, 13].

Sure, there were a lot of attempts to provide digital approaches. For example, using of cognitive IT platform Polyhedron [33] with it functions auditing [7, 8, 30] and ranking [9], virtual educational experiments [28], using of mobile Internet devices [15] and AR [14, 16, 17, 20], distance learning in vocational education and training institutions [19], on-line courses [34–36]. Also, there are a lot of approaches to provide STEM education [1, 3, 4, 25, 26, 29, 31].

✉ [sjb@man.gov.ua](mailto:sjb@man.gov.ua) (Y. B. Shapovalov); [svb@man.gov.ua](mailto:svb@man.gov.ua) (V. B. Shapovalov); [ukrpolic65@gmail.com](mailto:ukrpolic65@gmail.com)

(B. B. Shapovalov); [p.antonenko@coe.ufl.edu](mailto:p.antonenko@coe.ufl.edu) (P. D. Antonenko)

🌐 <http://www.nas.gov.ua/EN/PersonalSite/Pages/default.aspx?PersonID=0000026333> (Y. B. Shapovalov);

<https://www.nas.gov.ua/EN/PersonalSite/Pages/default.aspx?PersonID=0000029045> (V. B. Shapovalov);

<http://policehortihg.pcma.org.ua/?p=159> (B. B. Shapovalov);

<https://education.ufl.edu/faculty/antonenko-pavlo-pasha/> (P. D. Antonenko)

🆔 0000-0003-3732-9486 (Y. B. Shapovalov); 0000-0001-6315-649X (V. B. Shapovalov); 0000-0001-8565-123X

(P. D. Antonenko)



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However, its usage can't be provided widely if it wouldn't be declared in the educational programs. Now, the New Ukrainian School is used to provide modification of the educational process [2, 5, 11, 31]. It contains a list of the competencies that should be thought during education.

Currently, job seekers search uses web-based services that require very not standardized experience, skills and competencies. For example, such services are work.ua, rabota.ua, djinni.co (specialized for IT), etc. And it seems that the market required more digital-based skills than it declared in New Ukrainian school and educational programs of Ukraine. Also, it seems more relevant to use the results of employers requests on vacancies competencies to include them into educational programs and prognosing requests in future. Taking into account considered before, it seems relevant to develop approaches that synchronize the current state of education and job requirements for specialists. The study aims to describe an information system that provides data transfer on real-life required competencies from employers who provide demand on the competencies of job seekers to specialists in the Ministry of education and science to take them into account. The object of the study is an approach that provides taking to account real-life required competencies during providing of educational programs.

## 2. Methods

To provide study and develop solving approaches, the concepts developed by the Ministry of Education and Science of Ukraine were used to define the problem and provide background research. Also, taking to account growing the role of digital skills (competencies) in digital sociality, the proposed approach focused on digital competencies [10, 12, 21, 37], but not limited by them.

The Unified Modeling Language (UML) schemes were used to describe the informational system that may solve the problem of improving considering required real-life competencies during the development of educational programs. To describe the main actors of the proposed system, a use case diagram is developed. To describe the database, main classes in it and data for each class, a class diagram is developed. The ways of implementation and some features of it is described.

## 3. Results

### 3.1. Analysis of nonconformity of competency provided by education and requirements by employers

As it was noted before, there is the problem of nonconformity of competencies given by teaching and required by employers. It means that some educational time is wasted. The competencies that are taught during the modern educational process of Ukraine in middle school is declared by the New Ukrainian School concept and its implementation in specific educational programs. However, competencies are required by employers and those declared by New Ukrainian School were not compared.

The employers seeking a person who can solve specific tasks he needs. For example, such skills

are knowledge of using MS Office, English level B2, using of Adobe Photoshop or knowledge of using of the textile machine. Also, the employer may require some measurable experience in some field (5 years working on environmental projects, 3 years of C++ coding). These competencies are very static, specific and easy to determine. Such requirements (competencies) may be named as “specific” and can be divided into “static skill-based” and “static experience-based” [24].

However, the competencies declared by New Ukrainian School has essential different nature and it is rather “abstract”, “wide” and “relatively static”. Using the term “abstract” we mean competencies that include more specific (in our classification – “static”) competencies. In this group, we propose to include mathematical competence, basic competencies in natural sciences and technologies, information and digital competence. For the term “wide”, we mean that it is not provided specific knowledge or skill but rather some dynamic abstract level. Also, the “wide” means that competencies are used in each of the decision-making. The analysis of competencies declared by the New Ukrainian School is shown in table 1.

**Table 1**

The analysis of competencies declared by New Ukrainian School.

| Competency type title | Description of competency type                                                                                | List of competencies                                                                                                                                                                             |
|-----------------------|---------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Abstract              | Impossible to measure, are very abstract and includes some more specific competencies                         | Mathematical competence; Basic competencies in natural sciences and technologies; Information and digital competence                                                                             |
| Wide                  | Impossible to measure, is used during solving any of practical based-problems                                 | Ability to learn throughout life; Initiative and entrepreneurship; Awareness and self-expression in the field of culture; Social and civic competence; Environmental literacy and healthy living |
| Relatively static     | Possible to measure, but still relatively hard. However, accepted international levels may be used to measure | Communication in the state (and native in case of difference) languages; Communication in foreign languages                                                                                      |

As seen from table 1, the competencies declared by New Ukrainian School may not be used for the employer.

All noted before, makes the gap between skills provided by education and used in real-life work. It seems that it may be solved by standardization, defining of values of each competency and using simple well-known ranking mechanisms. Sure, the proposed method is not dedicated to violating market-based society, but it allows to prioritize the competencies that have not being taken to account before. Also, the idea of standardization can be used to define a median salary for jobs that required specific skills. That can be used by students to decide skills that are required by digitalized sociality.

## 3.2. Proposed approach

### 3.2.1. Using ranking tools to evaluate digital competencies of the job seekers

To solve the problem, it seems relevant to use measurable competencies (such as “static skill-based” and “static experience-based”) that may be processed. By their processing, it may be used to obtain a general integrated score of the corresponding of the person to the vacancy.

Also, it seems relevant to use the importance of competency in the vacancies description. As for digital specializations, such skills will provide a core score for Job seeker’s evaluation, but for other specializations in digitalization of sociality, it may provide up to 50% of the ranking score.

Such a ranking approach will provide a win-win situation during the job-seeking process. Employers will decrease role and load on the company’s HRs. Job seekers will be evaluated objectively and receive reasonable estimates that will be based on the general skills of job seekers, including digital. It is worth note, that it will not provide a waiver of HRs, but it significantly decreases their work amount and provides more accurate fair candidates selection. As a standard to create a relevant system of ranks inputted by the user, the document “job responsibilities” may be used.

So, the employers will use a well-known ranking tool that can be described by the modified equation of ontology-based ranking:

$$RANK_{abs(n)} = \sum (IMP_n \times \frac{V_n}{V_{max}}) \quad (1)$$

where  $RANK_{abs(n)}$  – ranking rank in absolute value for i’s node;  $IMP_n$  – importance coefficient for data of  $i$ -th object;  $V_n$  – the value  $i$ -th object;  $V_{max}$  – maximum value of the dataset.

For this, the class name of each data will be the name of the competency (skill); its numeric data ( $V_n$ ) will correspond to the mastery level of that skill; the importance ( $IMP_n$ ) is a level of such competency requested by the employer. So, each job seeker will obtain his personal RANK of corresponded for a specific vacancy. Such an approach will be also useful for job seekers due they will obtain the matrix of the RANKs for the vacancies they choose and define by themselves work that they are fitted and comfortable to do.

As it was noted before, in the digitalized sociality, the role of digital competencies will be always high. To prove it, the example the IT profession (junior front-end programmer) and non-IT professions (enterprise economist) vacancies RANKs is shown in table 2 and table 3, respectively. For the examples, to simplify understanding approximations of ranks and levels will be used. The competency level will be used in form of relative values (%).

As shown from table 2, Jobseeker 1 with RANK of 480 is more suited for vacancy than Jobseeker 2 with RANK of 400. Also, digital skills are valuable for non-IT specialists as it is shown in table 3.

As it is shown in table 3, Jobseeker 2 has higher hard Bookkeeping skills, but low IT skills and generally it will be less suitable for the vacancy than Jobseeker 1. That proves that the proposed approach will be useful in the digitalized world for both, IT specialists and non-IT specialists. However, it requires providing of certification program providing to define the competency level (numeric data).

**Table 2**

Example of RANKing the junior front-end programmer.

| Class name (competency name) | Mastery level of the skill ( $V_n$ ) (numeric data), % | Importance ( $IMP_n$ ) requested by the employer | $RANK_n$ of the skill | General RANK score |
|------------------------------|--------------------------------------------------------|--------------------------------------------------|-----------------------|--------------------|
| <b>Job seeker 1</b>          |                                                        |                                                  |                       |                    |
| CSS coding                   | 50                                                     | 5                                                | 250                   | 100                |
| HTML coding                  | 30                                                     | 4                                                | 120                   |                    |
| MS office skills             | 50                                                     | 2                                                | 100                   |                    |
| Business analysis            | 10                                                     | 1                                                | 10                    |                    |
| Geography skills             | 10                                                     | 0                                                | 0                     |                    |
| <b>Job seeker 2</b>          |                                                        |                                                  |                       |                    |
| CSS coding                   | 20                                                     | 5                                                | 100                   | 83                 |
| HTML coding                  | 70                                                     | 4                                                | 280                   |                    |
| MS office skills             | 10                                                     | 2                                                | 20                    |                    |
| Business analysis            | 0                                                      | 1                                                | 0                     |                    |
| Geography skills             | 50                                                     | 0                                                | 0                     |                    |

**Table 3**

Example of RANKing the enterprise economist vacancy.

| Class name (competency name)        | Mastery level of the skill ( $V_n$ ) (numeric data), % | Importance ( $IMP_n$ ) requested by the employer | $RANK_n$ of the skill | General RANK score |
|-------------------------------------|--------------------------------------------------------|--------------------------------------------------|-----------------------|--------------------|
| <b>Job seeker 1</b>                 |                                                        |                                                  |                       |                    |
| Bookkeeping                         | 80                                                     | 5                                                | 400                   | 100                |
| Bookkeeping Law understanding level | 40                                                     | 5                                                | 200                   |                    |
| MS office using level               | 60                                                     | 3                                                | 180                   |                    |
| Analysis and reporting              | 60                                                     | 4                                                | 240                   |                    |
| General skills of PC using          | 20                                                     | 4                                                | 80                    |                    |
| <b>Job seeker 2</b>                 |                                                        |                                                  |                       |                    |
| Bookkeeping                         | 90                                                     | 5                                                | 450                   | 85                 |
| Bookkeeping Law understanding level | 60                                                     | 5                                                | 300                   |                    |
| MS office using level               | 10                                                     | 3                                                | 30                    |                    |
| Analysis and reporting              | 30                                                     | 4                                                | 120                   |                    |
| General skills of PC using          | 10                                                     | 4                                                | 40                    |                    |

### 3.2.2. Using of competency importance data to develop educational programs

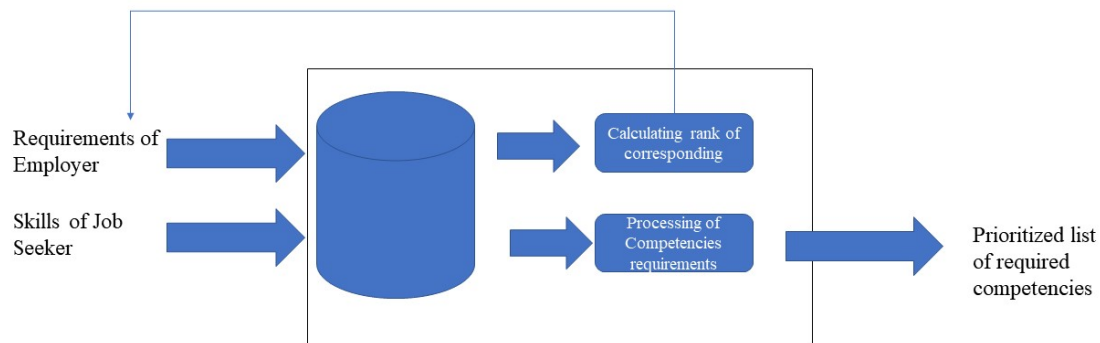
The developed approach will provide a collection of the employer's requests on competencies they need. So, it will be possible to use such data sets to generate real-life required skills and competencies.

To analyses the market requirements in competencies and modify the educational process, the most valuable is a set of Importance ( $IMP_n$ ) requested by the employer for each skill data. So, it may be represented as further:

$$\langle CN_{edu}, IMPC_{edu} \rangle = RANK(\langle CN_n, IMP_n \rangle) \quad (2)$$

$\langle CN_{edu}, IMPC_{edu} \rangle$  – cortege of skills and its values recommended for education;  $RANK(\langle CN_n, IMP_n \rangle)$  – ranking results of each element of cortege of skills and their importance for the employer ( $\langle CN_n, IMP_n \rangle$ ).

The general workflow is using such a system provides obtaining of data set (cortege) of required by Employer competencies and its importance. Such data is processed by the system and it provides both, the results of corresponding of Job Seeker to the vacancy and obtaining a set of importance competencies values used for the development of education programs (figure 1).



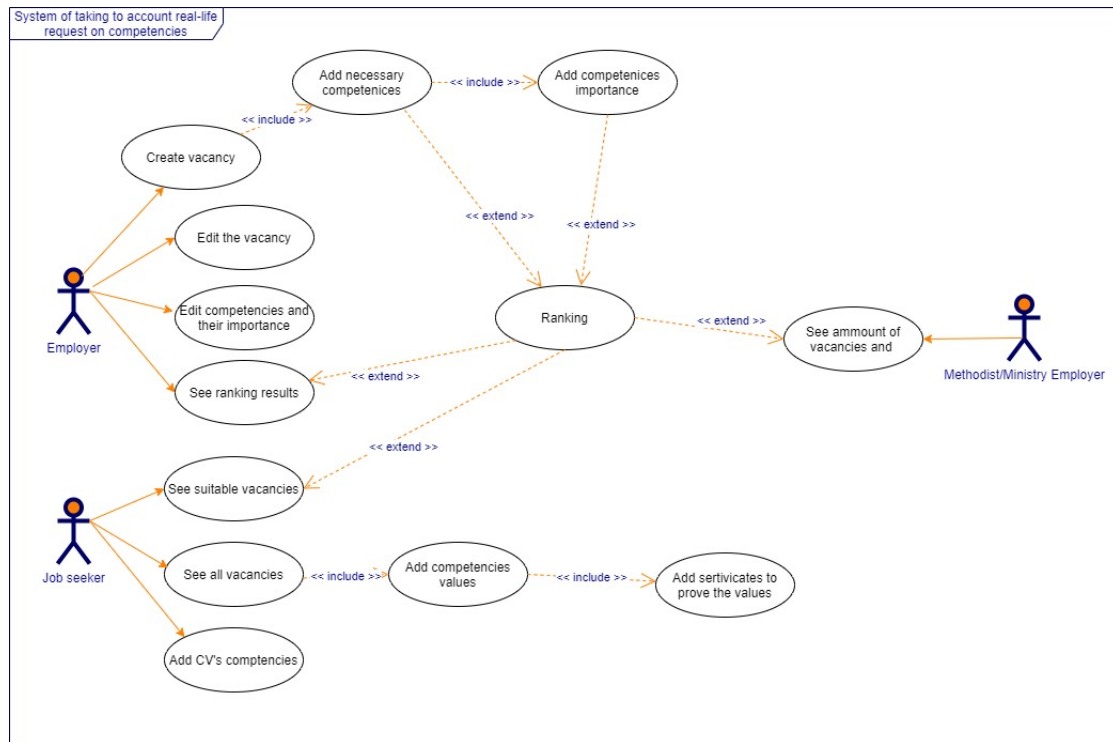
**Figure 1:** Workflow of data in proposed system.

### 3.3. Practical developments

To describe the approach, it will be simplified. The main actors of the proposed system are an employer that generates demand on competencies and a methodist that uses that demand on competencies to lay down it into educational programs. Also, there is an actor called Jobseeker. That actor is already an educated person who is already characterized by some stack of competencies.

There are a lot of functions of each actor, but only the most important actions will be described. The employer creates the vacancies and adds required competencies with the importance of the job. The required for vacancy competencies and their importance are used to provide a ranking of the corresponding specific job seeker with its stack of competencies with a vacancy. Such ranking results are used by Ministry specialists to analyze it and lay down the most required competencies into educational programs. The use case diagram of the proposed approach is shown in figure 2.

To create such a system, the classes that correspond to actors and actions are used. First of all, there are classes that described actors themselves and they are Jobseeker, Employer and Ministry



**Figure 2:** Use case diagram of proposed approach.

Employee. Each of such classes has person identifiers due they are describing actors. Each Job seeker has its personalized set of competencies called “Job seeker’s set of the competencies”. Each Job seeker’s set of competencies consists of competencies (skills), competency’s (skill’s) level and certificates that prove it.

Each Employer looking for Job seeker and finding it creates a vacancy. Each employer can create multiple numbers of Vacancies and it creates a library of them called Set of Vacancies. Each vacancy has data about competencies and the importance of them to provide Vacancy’s activities well. Job seeker’s set of competencies is used to provide a ranking that defines corresponding of its to Vacancy’s RequiredCompetency and CompetencyImportance.

Set of Vacancies with its data CompetenciesAndImportance is used by Ministry employees (methodists) to modify the educational program that has an array of StudiedCompetences. The list of database entities in form of a class diagram is shown in table 4 and figure 3.

The proposed Use case diagram and Class diagram will be useful to developing real-life systems.

## 4. Discussion

The proposed concept may be realized as well using simple basic tools such as MS Excel and as well by specialized tools such as KIT Polyhedron [27, 32] and by using Python.

**Table 4**

Description of the classes of UML class diagram of proposed system.

| Class name                           | Class attributes                                                                                                                                                                                                                                                                                |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Job seeker                           | + ID: int<br>+ name: string<br>+Job seeker's set of the competencies: array(Competency (skill), Competency's (skill's) level)<br>AddNewCompetency(string): text<br>AddCompetency's(skill's)Level: int<br>AddCertificate:link<br>display(set of the competencies): list(set of the competencies) |
| Competency's (skill's) level         | + ID: int<br>+ value: int                                                                                                                                                                                                                                                                       |
| Competency (skill)                   | + ID: int<br>+ name: string<br>+ ID: int                                                                                                                                                                                                                                                        |
| Certificate                          | + name: int<br>+file: link<br>+authority:name<br>+sertificates: list(certificates)                                                                                                                                                                                                              |
| Job seeker's set of the competencies | + SetOfCompetencyLevel: array Competency (skill);<br>Competencies(skill)level<br>Display(Competency(skill)): list(Competency(skill))<br>Display(Competency's(skill's) level): Competency's (skill's) level<br>++ ID: int                                                                        |
| Ranking                              | + rank: int<br>+ get(Job seeker's set of the competencies):array (Job seeker's set of the competencies)<br>+ get (RequiredCompetenices): array(RequiredCompetenices):<br>+ get (CompetenicesImprotance) array (CompetenicesImprotance)<br>+ Id: int                                             |
| Employer                             | + name: text<br>+create(Vacancy):array(Vacancy)<br>+display(Job seeker's set of the competencies)<br>+ Id: int<br>+ name: text                                                                                                                                                                  |
| Vacancy                              | + Desription: text<br>+ RequiedCompetenices:array<br>+ CompetenicesImprotance:array<br>+Vacancynames(Vacancyname): array                                                                                                                                                                        |
| Set of the vacancies                 | +CompetenciesAndImportance<br>(VacancyRequiedCompetenices);VacancyCompetenicesImprotance:array<br>+ Id: int                                                                                                                                                                                     |
| Ministry employee                    | + name: text<br>+ displayRequiedCompetenices:array<br>+ displayCompetenicesImprotance:array<br>+ modify<br>+ users: list(User)                                                                                                                                                                  |
| Educational program                  | + TextOfProgram: text<br>+ StudiedCompetenices:array                                                                                                                                                                                                                                            |



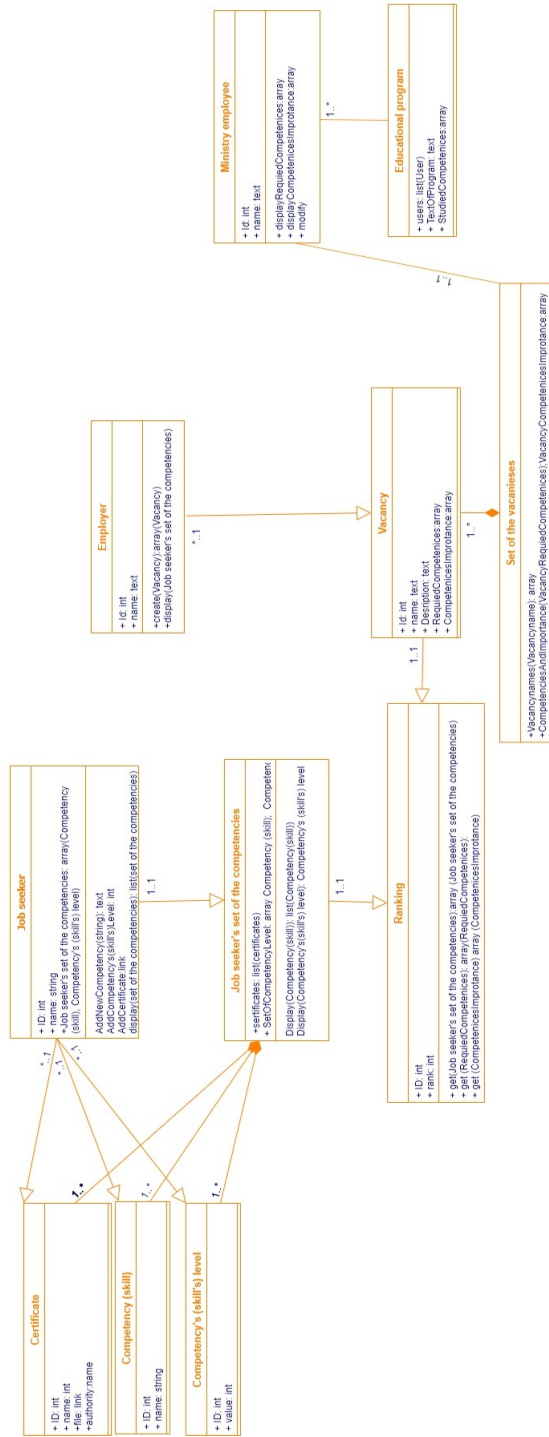


Figure 3: UML Class diagram of the proposed system

Also, the proposed approach is seeming relevant to use in stack with modern semantic ontology-based technologies [18, 23] and neural networks to provide analysis and predictions.

Sure, during using simplified tools such as MS Excel or Google Sheets it will not be an informational and communicational system and it won't be possible to communicate with it using API. However, it will be possible to provide all required functions. For the Excel-based approach, libraries of skills "CompetencyName" will be located in a separate sheet and used as a drop-down list.

Also, another important question to be solved is data collection. Using google forms to create vacancy profiles and cortege on importance and competencies is the simplest way to do it. Such google form can collect Vacancy's "name" "Description", "RequiedCompetenices" and "CompetenicesImprotance". Another form may be used to collect data on Job seeker's set of competencies.

Sure, it is the most common and simple way. In real life, the system will be created using full-stack (back end and front end) development. However, in further studies, all, MS Excel-, Ontology- and Python-based tools will be developed to make concept proof test.

The proposed approach even a simple way of application will be useful and will provide an effective way to taking to account real-life required competencies.

## 5. Conclusion

It is shown that some competencies that are required in real life are not prioritized in educational programs. The study describes an information system that provides data transfer on real-life required competencies from employers to specialists in the Ministry of Education and Science and methodists consider them.

The main actors in the proposed systems are Employer, Job Seeker and Ministry specialist (methodist). The main classes in proposed systems are Jobseeker Competency's (skill's), level Competency, (skill) Certificate, Job seeker's set of the competencies, Ranking Employer Vacancy, Set of the vacancies, Ministry employee, educational program. Each of these classes has the data that describes it.

The proposed concept may be realized as well using simple basic tools such as MS Excel and as well by specialized tools such as KIT Polyhedron and as by using Python. In further studies all, MS Excel-, Ontology- and Python-based tools to make concept proof test.

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