

Employee Development Program: A Generation Model for Project-based Learning Implementation at the University

Vasilii Borisov
Ural Federal University
Yekaterinburg, Russia
v.i.borisov@urfu.ru

Olga Podoliak
Ural Federal University
Yekaterinburg, Russia
o.o.podoliak@urfu.ru

Anastasia Markina
Ural Federal University
Yekaterinburg, Russia
aa.markina@urfu.ru

Valentina Ovchinnikova
Ural Federal University
Yekaterinburg, Russia
ova@urfu.ru

Abstract— This paper represents a methodological approach for university staff development programs; it should be considered at this juncture as a work-in-progress paper. The considered methodological approach's main feature is to create a personalized level assessment of the university staff competencies. This is accomplished through an analysis of the university's digital services capabilities, with the objective of facilitating the further development and implementation of project-based learning. Based on the evaluation, a unique prescribed educational path is formed for each employee, depending on his/her role in the project-based learning. This path is created considering not only the necessary competency levels of the individual, but also the participant's role in the project-based learning implementation. The methodological approach was tested as part of the project-based learning implementation at the Ural Federal University. Studies were conducted on a sample of 108 people tested. The proposed mechanism holds an undeniable advantage in its scalability and ease of implementation when making minor changes and updating content for a specific task. It is worth mentioning that it can be used at any level educational institution or in a private sector enterprise that is implementing employee training.

Keywords— *project-based learning, university staff training, digital services, personalized level assessment*

I. INTRODUCTION

Ural Federal University (UFU) is one of the largest universities in the Russian Federation, with about 36,000 students and more than 4,200 university staff. Over the past 10 years, new educational technologies have been actively introduced at UFU, to ensure a high rate of university development and demonstrating a measurable increase in competitiveness. The main development potential for each university are the demonstrable competencies of university staff, therefore special attention should be paid to the university staff's competence assessment and then articulating potential changes that can cause the university to improve its standing.

The relevance of the staff competencies possessed by a particular university should be analyzed and compared relative to current labor market requirements; this was considered in the works [1], [2], including the current cooperative efforts between universities and business at the EU and national levels. In [3] cooperation between university and business has been discussed. The main cooperation purpose is to develop a transnational education program on energy efficiency using the example of four European countries (Italy, Poland, Great Britain, and Greece). These investigations show a constant interest in the topic of university staff and education program adaptation in

connection with the needs of the digital economy and Industry 4.0.

Solving the problem under consideration is a complex task. Accordingly, research on it can be divided into different stages. Part of the work is devoted to the labor market study (its trends and requirements): in [4] market trend analysis based on an infographic approach method had been considered. In [5], [6] a web-based approach to the digital competencies analysis has been proposed.

In [7] an effective feedback system and monitoring of the transition from training to work methodological description has been created. On other hand, [8] is devoted to the methodology development that allows theoretical and practical components content that will harmonize in the educational disciplines with dynamically changing qualification requirements. Adaptive curriculum development has been discussed in [9]. In [10], [11] multi-agent modeling approaches were applied to create a dynamic and flexible system of competencies. The study presents a methodology for automatic comparison and modification of the various training programs following labor market requirements changes. In [12] – [14] are devoted to comparing ontological (philosophical) models of the market and educational institution to identify inconsistencies and add, remove or modify part of the competencies.

The possession of digital competencies is today a key factor in education and research development, which is confirmed by the growth of research in this area. In [15] the level of the university staff's digital competencies has been articulated. The results show that only 10% of respondents have a high level of digital competency (C1 and C2), for the remaining participants advanced training is required. A similar study was conducted in Poland [16] which also shows that the level of proficiency in university staff's digital competencies in various subject areas is insufficient for the successful integration of digital technologies into the educational process, and preliminary results of the study indicate the need to improve teacher's training programs in the field of digital competencies.

An investigation [17] was conducted to determine the theoretical and practical aspects of the teachers' advanced training model that would contribute to the digital technologies' introduction in the educational process.

An analysis world trends in education shows that one of the most important areas of activity in the teachers' advanced training, are the competencies assessment and training of

employees in digital technologies and services, for the following reasons:

1) ensuring the accelerated introduction of digital technologies in the economy and society in general, and connected with the national project of Russia "Digital Economy" [18];

2) commonly used distance and online learning due to the COVID-19 pandemic has shown that the quality of student learning directly depends on the university staff's skills in digital technology and services.

During the university staff's advanced programs developing in the digital technologies, it is necessary to take into account a large number of employees who need to be trained simultaneously and their different user's levels in the digital services and technologies area. Therefore, to increase the efficiency of training university staff in digital technology and services, it is necessary to form a personalized advanced program for an employee, that takes into account his current knowledge and skills and to indicate where he/she might expect to improve.

A methodology was developed according to the requirements already mentioned. The methodology describes a unified systematic approach for staff development, necessary for obtaining and updating employees' competencies, knowledge, and skills in working in the digital products and services (digital environment), based on the difference in their current proficiency level from the required level. According to the investigation, the need for individual training of university staff in their effective use of digital tools, is considered as a hypothesis.

Thus, the investigation goal can be formed as follows: developing a methodology for creating and constantly updating university staff training programs (different structural divisions and functional roles) utilizing the digital services of an educational organization.

Accordingly, we should formulate research questions, to which will lead us to some concrete solution:

- to create an approach for the development of a set of digital services skills and knowledge in the field by different categories of university staff in accordance with their position and role;
- to create a staff classification approach to form groups that are trained on specific information services of the university digital services in accordance with their job description or classification;
- to develop a methodology for assessing the employee's level of the University's digital services functionality using;
- to develop an approach to employee's digital competencies chart creating;
- to create principles, methods and approaches for the digital product and service development courses forming.

II. MATERIALS AND METHODS

A. General Organization and Implementation

Within the investigative framework, a methodology was created for forming an advanced program depending on the position requirements, as well as the digital competencies possession level. The advanced program consists of separate micro-modules, the selection of which is based on the digital

skills/competencies possessed relative to the position and his current knowledge level (baseline skill level). The advanced program's micro-module is a singular information educational resource (text document, video, simulation, etc.) that explains one specific function of a digital system or service. This approach allows creating a unique individual path for a particular user's needs.

Digital services' knowledge and skills level assessment is carried out both at the initial stage of methodology implementation, and when the significant conditions change, (position and/or functional role change, digital services modernization, etc.). This assessment is also needed as a monitoring tool, the results of which will increase the effectiveness in an educational institution of higher education.

The general organization and implementation principles of the competency level assessment system are presented in Table I.

TABLE I. GENERAL ORGANIZATION AND IMPLEMENTATION PRINCIPLES OF THE COMPETENCY LEVEL ASSESSMENT SYSTEM

Principle	Description
<i>Versatility</i>	The methodology is designed for use in different conditions: 1) for the initial analysis of the information environment in university; 2) to make an initial determination of individuals' level of digital competency in a university setting – this can be for current employees or for those that are going through an initial hiring process; 3) to monitor usage levels (hours per person); 4) for monitoring when implementing the digital systems and services functioning changes
<i>Adaptability</i>	Tests are formed according to the modular principle taking into account functional tasks performed in digital systems and services
<i>Cyclicity</i>	In order to level monitoring testing is carried out with a frequency of at least once a year, as well as when the services' functionality changes with the same functional role and position. Periodic evaluation allows assessment staff to determine the digital environment proficiency level dynamics, which is the basis for updating the employee's individual profile

The monitoring methodology describes the basic principles and approaches for conducting the user's level assessment of the digital systems and services used by a higher education institution. The evaluation should be systematic, so it is carried out by all university staff categories involved in the organization and implementation of the main and auxiliary processes of the organization, implemented using digital systems and services. The list of digital systems and services required for each category is determined in accordance with the employee's position and/or functional roles and is fixed in the digital competence chart (typical or unique).

B. Assessment Procedure

The most optimal form of assessment tests are those that can be formed to analyze a specific functional task that is

implemented through a digital system. University staff initial testing will allow:

- assess the compliance of job responsibilities (functional role) with the digital systems and services used in the higher education institution [12];
- assess the current level of the employee's use of the digital systems and services;
- define the gaps between job responsibilities (functional role) and digital systems and services used functions by an employee [6];
- determine an employee's proficiency level in using the digital environment systems and services;
- create (update) an employee personalized profile that shows the using proficiency of the digital systems and services;
- aggregate and analyze the results of university staff activities (in the digital systems and services) [10];
- assess the overall level of the digital systems and services usage;
- promptly monitor and systematize the causes of low service usage by different groups of university staff;
- identify regular error zones during the digital usage; keying on such parameters as usability, interface comprehensiveness, *etc.*

C. Approval

For the proposed approved methodology, the project training implementation case at the Ural Federal University was considered. 35 educational programs of the university introduced project training modules into their curriculum in the autumn semester of 2020. Within the project modules framework, students have to complete a project within a semester, the task for which is formulated by an external organization or one of the University departments, using project management approaches.

Each student's team has a project curator (a University tutor). The organizational support for the project training process is decided by the educational program head. The logic and technologies of project management differ from the traditional educational approaches at the University; in this regard, the new digital services introduction was required, and as a result, the training of the university staff involved in this process became necessary.

In total, in the autumn semester, 2350 University students passed through project training, so it was necessary to train at a time more than 100 tutors with different usage levels. It was decided to form the advanced program concerning the digital services that are involved in the project training implementation. The University staff was able to choose one of the possible directions: "Project Curator" or "Educational Program Manager".

III. RESULTS

Based on the requirements for the training process individualization, the need to train a large number of university staff, and digital services' wide variety, an algorithm has been developed for the formation of personalized advanced training courses for different categories of university staff.

As a result of the proposed algorithm implementing from a common set of micro-modules (which includes instructions,

training videos, practical tasks) an individual set of these micro-modules for a particular employee should be formed. When forming such personalized training, the requirements for the level of digital competencies of a particular position and the actual level of employee competencies should be taken into consideration. Thus, the advanced program aims to teach only those skills that the university staff member lacks to successfully perform his work functions. The principle approach to the construction of the university staff development system is shown in Figure 1.

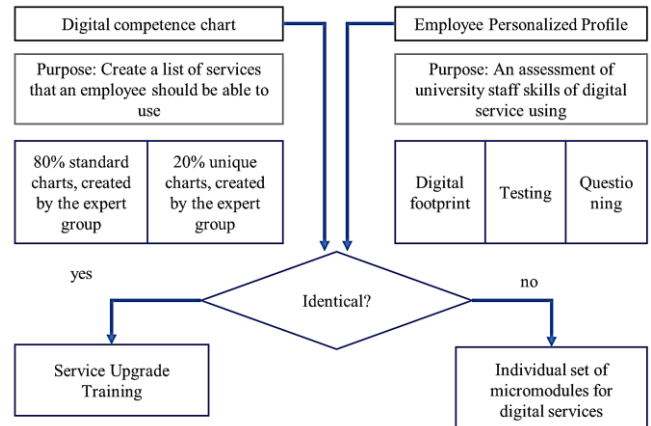


Fig. 1. The principle approach to the construction of the university staff development system

The advanced programs creating and updating process includes four main parts:

- 1) *zero stage*. The digital competence charts' creation and the training content preparation;
- 2) *the first stage*. The Employee Personalized Profile formation;
- 3) *the second stage*. The employees' individual educational trajectories formation;
- 4) *the third stage*. Employee's current competencies and digital competence charts' changes monitoring.

A. Zero Stage. The Digital Competence Charts' Creation.

The proposed methodology requires significant data collection at the zero (preparatory) stage of implementation, the purpose of which is to create the digital competence charts. The digital competence charts allow defining the requirements for the list and level of the digital competencies according to the position: tutor, researcher, administrator, *etc.* The digital competence chart is compiled by the experts' group if the position is typical (such as "tutor," "researcher," or "administrator").

If the position is unique (for example "dean's employee," "international program specialist,"), the digital competence chart is compiled by the head of the department. The head of the department should be able to modify and supplement digital competence charts of his employees in real-time using the digital system, which will be developed based on this methodology.

B. First stage. The Employee Personalized Profile Formation.

The employee personalized profile is formed based on the results of the employee's digital footprint, survey, and testing analysis. At the initial stage, information about the employee's digital footprint in the university's information systems is aggregated: the accounts and the login frequency.

Then, the employee is invited to answer a survey to assess his/her degree of awareness of the particular digital service capabilities. And at the last stage of the employee's creating a personalized profile, the employee will answer a survey, which allows identifying the digital services users' competence level.

C. Second Stage. The Employees' Individual Educational Direction.

The individual educational direction consists of micro-modules containing information about the work of the digital service required for the employee. The individual educational direction formation is based on comparing the results of the employee's digital footprint analysis, survey and testing results with the digital competence chart. If the test results and digital competence chart data for a specific function of digital service or system do not match each other, this function is added to the advanced program as mandatory for training. The algorithm for assigning micro-modules to the employee is presented in Figure 2.

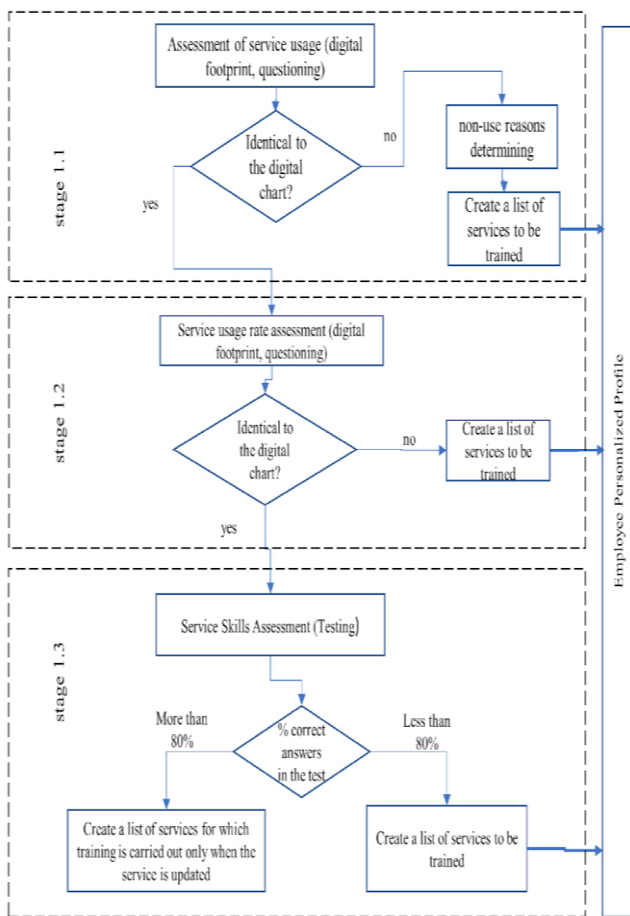


Fig. 2. Block diagram of the micro-module assignment algorithm

D. Third stage. Employee's current competencies and digital competence charts.

Transferring an employee within the organization to a new position, when assigning a new functional role and expanding the employee's functionality, the algorithm for assigning educational modules will consist of 2 stages (As shown in Figure 3).

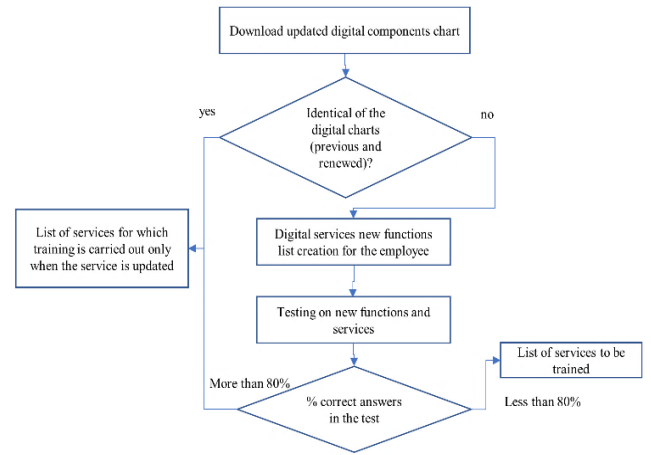


Fig. 3. Employees' individual educational direction formation

Data on the completed training, test results, and performed tasks as part of advanced training programs should be stored in the personalized employee profile and can be taken into account as one of the criteria when making personnel decisions. In this way, the system will accumulate the employee's digital footprint and information about digital services user's skills.

IV. APPROVAL AND DISCUSSION

During the methodology approval, the experts' group formed digital competence charts and determined threshold values of the tests. This stage of the model implementation is related to the work of experts' groups to identify the digital services' functions, priority determination; the thresholds and required values determination, the digital competencies achievement level for various positions (as shown in Table II).

TABLE II. DIGITAL COMPETENCE CHARTS

Role	Digital service	Requirement	The range of points scored in the initial test to assess the level of competence							
			A2		B1		B2		C1	
Educational Program Manager	Initiating a project	B2	1,85	2,77	2,77	3,70	3,70	4,16	4,16	4,62
	Building project teams	C1	1,32	1,98	1,98	2,64	2,64	2,97	2,97	3,30
	Interaction of project teams	B1	5,54	8,32	8,32	11,09	11,09	12,47	12,47	13,86
Project Tutor	Initiating a project	B1	1,85	2,77	2,77	3,70	3,70	4,16	4,16	4,62
	Building project teams	A2	1,32	1,98	1,98	2,64	2,64	2,97	2,97	3,30
	Interaction of project teams	A2	5,54	8,32	8,32	11,09	11,09	12,47	12,47	13,86

Afterward, a bank of test items was compiled for the functions of digital services for project learning and threshold values for the levels of digital competence were determined for each of these three services. Testing was passed by 105 university employees: 29 employees in the direction of "Project Tutor" and 76 in the direction of "Educational Program Manager".

As part of the methodology creation, a software implementation was realized. The software allows to automate the individual training program development process. The services and functions priority was determined by the working group at the stage of digital competence chart creating.

The program carried out an analysis for each employee who took part in the testing by comparing his current level of competence and the required level for the selected role (A2, B1, B2, C1). Next, the competence level of the digital competencies included in the chart is compared with the level obtained from the test results, on the basis of which the program:

- generates a list of recommended micromodules if the level is lower;
- if the levels matches, it does not create a list of micromodules;
- if the question block for one function is not fully answered or is answered with 0 points, then it forms a recommendation for mastering a specific module.

The program then analyzes the results of employee testing and builds "heat maps" of the competence level for each service and functions of it. The Table III shows an example of how the program works for a particular employee.

TABLE III. EXAMPLE OF APPROVAL RESULTS

user_id	Role	Service	Number of mistakes	Number of competence
usr1809202016	Project Tutor	Interaction of project teams	1	T15
usr28082020001	Educational Program Manager	Building project teams	1	T8
usr28082020001	Educational Program Manager	Initiating a project	2	T5
usr28082020001	Educational Program Manager	Interaction of project teams	3	T15
usr1809202016	Project Tutor	Initiating a project	2	T2

Based on the analysis, a list of recommended micromodules in the format of links to training materials was formed for each employee who needs to improve their competencies.

As a result of the implementation, recommendations were obtained on the number of employees in need of training (from testing group of 105 employee) as shown in Table IV.

TABLE IV. TOTAL APPROVAL RESULTS

Digital service	The number of employees in need of competence improvement	
	Educational Program Manager	Project Tutor
Initiating a project	18	42
Building project teams	24	63
Interaction of project teams	26	63

In addition, the proposed software implementation allows to identify the "problem zones." Based on employee testing, heat maps are automatically generated for different services and functions, that allow to evaluate the most "problematic" functions of digital services in the context of functional roles. Such statistical based development will provide work optimization in the future.

The experience of recent years, especially in the light of world events, shows that the viability of any company depends on the ability of its employees to adapt to changes, quickly and effectively master new skills and competencies.

The purpose of the study was to create a new approach to the system of retraining employees in digital skills, which would contribute to increasing their flexibility and adaptability when introducing new educational processes at the university.

Analyzing obtained results, it is worth noting that the data obtained during the approval correlate with studies in this area carried out by various researchers [19, 20, 21], which once again emphasizes the need to create flexible systems for improving the qualifications of employees.

V. CONCLUSION

The presented methodology was developed following the tasks set: the principles and conditions for the formation of an individual educational direction, depending on the position held, were determined and defined. The level of competence in using the function of digital services and systems of the University was taken into account, and a model of the dependence of the formation of a set of micromodules on the level of possession of digital competencies was built; a list of conditions has been formed under which an employee must be trained in advanced training programs.

A feature of this technique is the principle of forming an individual educational direction under the digital competence chart of the position and the employee's personalized profile. This approach makes it possible to form an individual training program for a specific employee, taking into account the level of his competencies and the need for the position, which will ensure an increase in the quality of training, an increase in the speed of mastering digital competencies necessary to work with digital services of the university.

It should also be noted that the presented methodology was formed taking into account the possibility of its application in any organization of higher education that uses a digital environment for the implementation of educational, administrative, and management activities.

ACKNOWLEDGMENT

We also express our gratitude to Maria Mukoseeva (Deputy Director at Department of International Educational Programs, Ural Federal University) for attention to our work.

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