ATLANTIS PRESS
Advances in Social Science, Education and Humanities Research, volume 333
Humanities and Social Sciences: Novations, Problems, Prospects (HSSNPP 2019)

Monitoring the Formation of Business Analytical Competences among Students of Economic Specialties

Sannikova N.I.
Institute of Digital Economics
Khanty-Mansiysk Yugra State University
Khanty-Mansiysk, Russia
sannikova_ni66@mail.ru

Kutyshkin A.V.
Institute of Digital Economics
Khanty-Mansiysk Yugra State University
Khanty-Mansiysk, Russia
avk_200761@mail.ru

***Abstract* — The article addresses the problem of the necessity and relevance of the formation of business and analytical competences among students of economy majors within disciplines connected with information technologies. The paper provides with the characteristic of the problem-oriented module on the basis of ARIS Methodology used for training students. Authors analyze the results of the formation of business and analytical competences among students of Institute of Digital Economics, Ugra State University, who are studying the following majors: "Economics", "Economic Security" and "Human Resource Management".**

Keywords – competence, business analysis, students of Higher School of Economics, ARIS methodology

I. INTRODUCTION

According to Business Analysis Body of Knowledge (BABOK) [1, 2], Business Analysis is commonly understood as multifaceted activity within an organization that helps to analyze and make decisions related to its functioning and development. Comprehending and analyzing the problems that have arisen in the functioning of the company and developing measures to eliminate them, the business analyst must also solve the tasks of implementing the relevant changes, while interacting with all the interested parties. The implementation of the proposals and measures developed by the business analyst to eliminate the company's problems identified by him or her rests directly with its management. The business analyst acts as an intermediary between all participants of the planned changes, taking over on the analysis of this situation, identifying and formulating proposals and requirements for changes in business processes and for information support of the business system's activities, and also, possibly, for corporate ethics and company policy. Currently, the solution of such tasks is based on the use of specialized problem-oriented software, which, as a rule, is integrated with information systems operated by companies. Thus, a business analyst should be sufficiently well aware of how an organization (business system) that he or she is considering functions, what are the sources and factors of the problems that arise in doing so, and also to identify and use the existing opportunities for their elimination in the context of the goals of its development which are designated by its management. Therefore, the determining factor in the effectiveness and efficiency of his or her work is competence in solving problems related both to determining and collecting the necessary information about the functioning of a business system, analyzing this information, forming and substantiating relevant conclusions, developing their organizational and technical decisions and participation in their implementation. This, according to the authors, actualizes the task of training this kind of specialists, which is confirmed by the growing demand for them on the labor market [3].

II. FORMATION OF BUSINESS AND ANALYTICAL COMPETENCES WHEN TRAINING STUDENTS OF ECONOMY MAJORS.

The list of professional competencies of a business analyst, taking into account the position held in the company and his or her work experience, is presented in the document "Business Analyst Competence Models v 2.0". It was designed by Higher School of Business Informatics of Federal State Autonomous Educational Department of Higher Education "National Research University "Higher School of Economics" [4]. As a result of the analysis of the business and analytical competences (BAC) given in this work, the authors established and proved correspondence [5] in competences referred to positions: "business analyst of initial level" and "junior business analyst" with work experience less than one year, and a number of professional competences (PC) formed within the discipline "Methodology and Tools for Business Processes Modeling" [5, 6] (Table 1). According to the authors, the discipline above is rather close to the following disciplines by its content: 1) Information Technologies in Economy (FSES of Higher Education, field of study "Economics" 38.03.01 (Bachelor) from 12.11.2015 No. 1327); 2) Information Systems in Economy (FSES of Higher Education, field of study "Economic Security" 38.05.01 (Specialist) from 16.01.2017 No. 20); 3) Information Technologies in Human Resource Management (FSES of Higher Education, field of study "Human Resource Management" 38.03.03 (Bachelor) from 14.12.2015 No. 1461) [7, 9].

Therefore, it is advisable to use a part of study hours for formation of these competences within the course of these disciplines. With this purpose special resource materials have been developed as far as special programming tools have been deployed.

The following methodologies and approaches served as the basis for programming tools selection, as they appear to be the most compelling for describing, modeling and analysis of business systems and processes functioning [10,11]:

- Methodology of Data Flows Modeling (Standard - Data Flow Diagramming (DFD);
- Methodology of Structure-functional Modeling (Standard – Integrated Definition IDEF0, IDEF3);
- Object-oriented Approach to Business Processes Modeling based on the Unified Modeling Language (UML);
- Methodology based on the display of business processes when modeling work flows (Business Process Model and Notation);
- Methodology of Architecture of Integrated Information Systems (ARIS).

TABLE I. COMPETENCES ON THE DISCIPLINE "METHODOLOGY AND TOOLS FOR BUSINESS PROCESSES MODELING" [5,6]

Competence	Federal State Educational Standard (FSES)/National Research University Code	Descriptors (Result achievement indicators)	Forms and methods of training, contributing to the formation and development of a competence
To define common goals in professional and social activity and to involve public in their implementation .	PC-3 (BAC-1)	Defines the purposes of modeling a business system, provides arguments for selection of models and levels of specification for description of the organization's subsystems.	Lectures, seminars, practical classes and laboratory works, educational projects
To create, describe and responsibly control implementation of the production requirements and standards in professional activity.	PC-9 (BAC-2)	Creates databases of models, creates models of a production working plan according to the studied course on methodology of modeling and project documentation.	
To apply methods of the system analysis and modeling for the purpose of assessment, design and working out a development strategy for the enterprise architecture.	PC-13 (BAC-3)	Defines properties of the organization as a system, defines borders and factors of the business system self-organization, reasonably provides evidence for the choice of model types, attributes and properties of the objects.	

Authors consider that ARIS Methodology realized by free software of ARIS Express Company (IDS Scheer AG, Germany) is expedient to use for the analysis of the organizational and informational structure of a business system and for the analysis and modeling of its business processes [12-14]. This product supports the design of business processes charts in such notations as IDEF, BPMN and others. Along with that, ARIS Express provides creation of its own chart types. This product allows to carry out cost analysis of business processes of the organization, analysis of employed resources workload, analysis of business processes informational integrity and to reveal vulnerable points. Besides, this product allows to imitate modeling of the analyzed business processes functioning. Models of a business system and its processes realized in ARIS Methodology and supported by ARIS Express product provide students with gaining general business analytical competences presented in Table 1 (Table 2).

TABLE II. COMPLIANCE OF BUSINESS AND ANALYTICAL COMPETENCES AND MODELS OF ARIS METHODOLOGY

No.	ARIS Methodology Model	Corresponding Business and Analytical Competences (BAC)
1	Organizational chart	BAC-1, BAC-2
2	Function Tree	
3	Value Added Chain Diagram (VACD)	
4	Professional Competence Diagram and Extended Event driven Process Chain (eEPC)	
5	Professional Competence Diagram and Extended Event driven Process Chain (eEPC)	BAC-1, BAC-2, BAC-3
6	Extended Entity - Relationship Model (eERM)	

In order to ensure the formation of business and analytical competences (Table 2) within undertaken disciplines, special resource materials [5] of a problem-oriented module which enrolls six lectures with three units on the following topics, have been developed and introduced:

Unit 1 – Concept of ARIS Methodology (2 hours);

Unit 2 – Modeling in ARIS Environment. Types of models and levels of the processes description (2 hours);

Unit 3 – Data Model in ARIS Environment (2 hours).

The calculation of study hours for a subject matter was performed by the following technique: "…first – to define the volume of training material on the subject. For this purpose, the total number of subject characters needs to be defined, using Word's software Statistics tool.

Second – to estimate the timing needed to fully cover the training material, taking into consideration that the speed of processing visual information corresponds to 3.37 - 6.74 characters per second (1):

$$ti = ni \times S'_1 \quad , \qquad (1)$$

where *ti* is the time necessary for studying of each subject; *ni* is the number of subject characters without space; S'_1 - 3.37 (6.74) characters per second." [15].

Taking all the calculations, the total amount of training material on Fundamental ARIS Methodology constituted 44 596 characters without space. The total amount of time needed to cover the training material with the speed of processing information of 3.37 characters per second constituted 13 233 seconds = 221 minutes = 4 hours 41 minutes (Table 3).

TABLE III. VOLUME OF THE TRAINING MATERIAL ON FUNDAMENTAL ARIS METHODOLOGY

No.	Unit	Characters without space	Time needed to cover the subject	
			Seconds	*Study hours in minutes*
1.	1. The concept of ARIS Methodology	6221	1846	31
2.	2. Modeling in ARIS Environment. Types of models and levels of the processes description	573	170	3
3.	2.1 Organizational chart	1765	524	9
4.	2.2 Function Tree	951	282	5
5.	2.3 Value Added Chain Diagram Model (VACD)	6744	2001	33
6.	2.4 Professional Competence Diagram and Extended Event driven Process Chain (eEPC)	5344	1586	26
7.	2.5 Levels of models performing	4945	1467	24
8.	3. Data Model in ARIS Environment	297	88	1
9.	3.1 Basic Entity – Relationship Model (ERM)	5389	1599	27
10.	3.2 Extended Entity - Relationship Model (eERM)	0	0	0
11.	3.2.1 Model expansion by means of design operators	6621	1965	33
12.	3.2.2 Expansion of Power concept	2097	622	10
13.	3.2.3 Identification and essential dependence	1321	392	7
14.	3.2.4 Modeling of the technical terms used in the company. Technical Term Models	1172	348	6
15.	3.2.5 eERM Attribute Allocation Diagram	1156	343	6
	In total	**44 596**	**13 233**	**221 (4 h 41 min)**

These resource materials also presuppose laboratory practice which consists of nine laboratory works, five aimed to gain BAC-2 and four aimed to gain BAC-3 (Table 4).

The purpose of laboratory practice is to ensure students to understand the organization business processes; to teach students to analyze and imitate typical business processes in a number of fields on the basis of ARIS Methodology; to obtain a skill of working with ARIS Express Software.

TABLE IV. LABORATORY WORKS TOPICS DISTRIBUTION BY BUSINESS AND ANALYTICAL COMPETENCES

No.	Laboratory Work and Topic	BAC-1	BAC-2	BAC-3
1	Building an organizational structure of the enterprise.	---	1	---
2	Building a function tree of the enterprise - Function View.	---	1	---
3	Building extended Event Driven Process Chains.	---	1	---
4	Building Value Added Chain Diagrams.	---	1	---
5	Building an extended Entity-Relationship model.	---	1	---
6	Description of documents and data.	---	---	1
7	Models content analysis.	---	---	1
8	Building a processes scheme based on standard model IDEF0.	---	---	1
9	ARIS Simulation.	---	---	1

Performing individual tasks listed in Table 4 of laboratory work, a student acquires the skills to solve a number of key tasks for analyzing and modeling the functioning of the considered organizational and technical system (enterprise) and its basic business processes:

- a hierarchically ordered model of the organizational structure of the enterprise is being developed and analyzed, including taking into account the territorial location of the dedicated units;
- based on the developed structural model of the enterprise, its functional model ("tree of functions") is formed, describing the main business processes, i.e. carried out structural-functional modeling and analysis of the functioning of the enterprise in question;
- key business processes of the enterprise are being identified, and the corresponding models are developed which allow to describe and quantify the formation of value added of the products manufactured by the enterprise or the services provided to consumers;
- an information model of the enterprise in question is being developed which is integrated with previously constructed models, designed to describe and analyze the entire set of data characterizing its functioning;
- simulation of the functioning of the identified main business processes of the enterprise under consideration is carried out using the previously developed corresponding functional and information models.

The maximum score for laboratory work was equal to 5 points. Maximum score of 5 points was granted when a student performed excellent knowledge and understanding of the studied material; gave correct and deliberate answers within the studied topics; was able to use independently the gained

knowledge; used proper language forms while presenting oral tasks and did not make mistakes.

The score of 4 points was granted when a student performed rather good knowledge and understanding of the studied material; gave correct and accurate answers within the studied topics; used proper and correct language forms while presenting oral tasks and did not make serious mistakes; made only minor mistakes in written tasks.

The score of 3 points was granted when a student showed satisfactory knowledge and understanding of the studied material, though had difficulties with implementation of the gained knowledge on practice; was able to overcome difficulties with small help of the examiner; misinterpreted the material and made mistakes when giving oral and written answers.

The score of 2 points was granted when a student showed lack of knowledge on the studied material; struggled to give correct answers and needed the examiner's help; made frequent and serious mistakes in written tasks.

The score of 1 point was granted when a student was not able to give main definitions; was not capable to perform independently during laboratory works; was not familiar with the theory; copied other students' works; carried out tasks from the examiner's dictation.

Maximum score given for 9 laboratory works was equal to 45 points: 25 points – BAC-2, 20 points – BAC-3.

Thus, along with the consolidation of the theoretical knowledge gained by the students in studying the materials of a problem-oriented module the structure and content of which is described above, a student is developing his or her practical skills in formulating and solving a number of typical tasks that entry-level business analysts and junior business analysts often face in their professional activities [4,5].

III. Monitoring the Formation of Business and Analytical Competences on the Basis of ARIS Methodology

48 students of Institute of Management and Economics of Yugra State University participated in the research within three subject matters: Information Technologies in Human Resource Management (ITHRM) – 16 people; Information Systems in Economy (ISE) – 15 people; Information Technologies in Economy (ITE) – 17 people.

The amount of time for studying ARIS Methodology constituted: 6 hours of lectures, 8 hours of laboratory works.

Tests on ARIS Methodology included 62 question: 39 questions of closed form, 12 questions of open form, 3 tasks on enumerating, 8 tasks on matching (Table 5). Testing was held on the training MOODLE platform [16]. The best results were shown by the students of the discipline Information Technologies in Economy – 54.23%. The students of the discipline Information Systems in Economy performed 4.94% worse, and the students of Information Technologies in Human Resource Management – 17.18% worse (Table 6).

TABLE V. Test tasks on ARIS Methodology

	Total	Closed form	Open form	Enumerating	Matching
Unit 1 - Concept of ARIS Methodology	15	10	3	1	1
Unit 2 – Modeling in ARIS Environment. Types of models and levels of the processes description.	32	19	6	2	5
Unit 3 – Data Model in ARIS Environment.	15	10	3	0	2
In total	**62**	**39**	**12**	**3**	**8**

The ITE students showed the best result in Unit 1 - Concept of ARIS Methodology (54.90%) and in Unit 3 – Data Model in ARIS Environment (48.69%). This was by 7.68% and 12.03% better than the ISE students' result, and by 26.25% and 4.94% better than the ITHRM students' result respectively (Fig. 1).

The ISE students showed the best result in Unit 2 – Modeling in ARIS Environment. Types of models and levels of the processes description (63.97%), which was by 4.87% better than the ITE students' result and by 25.22% better than the ITHRM students' result (Fig. 1).

TABLE VI. Test results on ARIS Methodology

	Average %	Unit 1 - Concept of ARIS Methodology, %	Unit 2 – Modeling in ARIS Environment. Types of models and levels of the processes description, %	Unit 3 – Data Model in ARIS Environment, %
ITE	54.23	54.90	59.10	48.69
ISE	49.29	47.22	63.97	36.66
ITHRM	37.05	28.65	38.75	43.75
Average	**46.86**	**43.59**	**53.94**	**43.03**

Lower results of the ITHRM students might be explained by the smaller amount of hours on studying the subject – 30 hours (14 lectures and 16 laboratory works). The amount of study hours for the ITE and ISE students constituted 48 hours (24 lectures and 24 laboratory works) and 70 hours (30 lectures and 40 laboratory works) respectively.

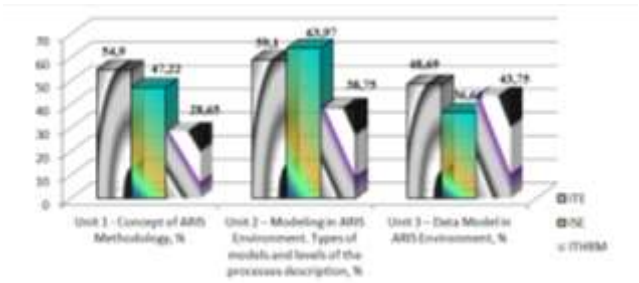

Fig. 1. Test results on obtaining business and analytical competences

All students performed successfully on laboratory works on obtaining business and analytical competences. All students successfully mastered the ARIS software interface and all the necessary tools for tasks on given algorithms while laboratory practice. BAC-3 is presupposed to be acquired within other subject matters during next years of training (3^d and 4th years).

IV. Conclusion

1. Nowadays, the formation of business and analytical competences among students of economy majors is one of high-quality vocational training components.

2. The average result on ARIS Methodology testing constituted 46.86%. The best result was performed in Unit 2 – Modeling in ARIS Environment. Types of models and levels of the processes description (53.94%). It was by 10.35% and 10.91% better than the result in Unit 1 - Concept of ARIS Methodology and Unit 3 – Data Model in ARIS Environment respectively.

3. The best test results on ARIS Methodology were performed by the students of the discipline Information Technologies in Economy (54.23%). The students of the discipline Information Systems in Economy showed 49.29% result, and the ITHRM students showed 37.05% result.

4. All students successfully performed during laboratory works in ARIS Express.

5. Therefore, the formation of business and analytical competences of economy major students within disciplines related to information technologies is possible.

References

[1] T. Kravchenko, “Training of specialists in the field of business analytics: experience of the Faculty of Business Informatics of the State University Higher School of Economics”, Business Informatics, no. 4 (14), pp. 54–59, 2010.

[2] V. Barilenko, “Preparation of business analysts”, Economic analysis: theory and practice, no. 33, pp. 42–47, 2011.

[3] N. Kazakova, “"Business analyst"” as a modern demanded professional standard on the labor market”, Accounting, Analysis, Audit, no. 2, pp. 106–112, 2016.

[4] Competency models of business analytics v 2.0. Retrieved from: http://hsbi.hse.ru/programs/vocational_retraining/information_business_analyst/#.Wk934biYAbY).

[5] Y. Gorchakov, The program of the discipline “Methodology and Tools for Modeling Business Processes”. Moscow, 2015. Retrieved from: https://www.hse.ru/ma/bi/courses/139334568.html

[6] N. Sannikova, A. Kutyshkin, T. Savina, “On the use of information technology in the formation of business and analytical competencies of bachelors of economics”, Innovations in education, no. 9, pp. 116–130, 2018.

[7] Order of the Ministry of Education and Science of the Russian Federation from 12 November 2015, no. 1327 “On approval of the federal state educational standard of higher education in field of study 38.03.01 “Economics” (Bachelor)”. Retrieved from: http://fgosvo.ru/news/5 / 1495

[8] Federal State Educational Standard of Higher Education in field of study 38.05.01 “Economic security” (Specialist) (approved by the order of the Ministry of Education and Science of the Russian Federation from 16 January 2017, no. 20). Retrieved from: http://fgosvo.ru/news/4 / 2218

[9] Order of the Ministry of Education and Science of the Russian Federation from 14.12.2015, no. 1461 (ed. 04/20/2016) “On approval of the federal state educational standard of higher education in field of study 38.03.03 "Human Resource Management" (Bachelor)” adopted by Justice Ministry of the Russian Federation from 19.01.2016, no. 40640). Retrieved from: http://www.consultant.ru/document/cons_doc_LAW_ 192913/.

[10] A. Vichugova, “Methods and means of conceptual design of information systems: a comparative analysis of the structural and object-oriented approaches”, Applied Informatics, no. 1 (49), pp. 56–65, 2014.

[11] S. Kovalev, V. Kovalev, “Modern methodologies and standards for describing business processes: advantages, disadvantages and areas of application”, Economist’s Reference Book, no. 11, pp. 1–35, 2006.

[12] I. Voynov, S. Pudovkina, A. Telegin, Modeling of economic systems and processes. Experience of building ARIS models. Chelyabinsk: SUSU, 2002.

[13] V. Lelyuk, A. Lelyuk, N. Pan, Improving business systems. Methods, tools, experience: textbook. Translated from Ukraninan. KNAMH, 2011.

[14] V. Morozova, K. Vrublevsky, Modeling business processes using ARIS methodology: teaching resource materials. Moscow: RUT (MIIT), 2017.

[15] N. Sannikova, “Programming the educational process in theoretical disciplines in the system of higher professional education in physical culture using mathematic-pedagogical algorithms,” Thesis abstract. Moscow: RSUPE, 2006.

[16] Testing in the LMS Moodle. Retrieved from: https://lms-3.kantiana.ru/mod/book/view.php?id=87&chapterid=97.