Business Analysis Learning Perspectives in ICT Education

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Abstract

This paper aims to develop a practical learning framework with the implementation of business analysis methods in ICT education. General issues of business analysis applicable in ICT education are analyzed. The BABOK Guide describes knowledge areas for business analysis, as well as tasks and main competencies, techniques, and perspectives concerning business analysis. Reasons for business analysis learning include its support with the case method and project-based learning including the development of students' hard and soft skills. We prioritize business analysis and exercises and activities applicable to ICT education. Taxonomy of learning effectiveness indicators related to business analysis is developed together with a business analysis learning framework.

Keywords

BABOK, business analysis, business analyst, ICT education project-based learning, case study

1. Introduction

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"A Guide to the Business Analysis Body of Knowledge" (BABOK) [1] has been issued by the International Institute of Business Analysis (IIBA) as Version 3.0 in 2015. This document is provided to the business analysis (BA) community for educational purposes with describing knowledge areas for business analysis, as well as tasks and main competencies, techniques, and perspectives concerning business analysis. BABOK describes six knowledge areas of BA including planning and monitoring, elicitation and collaboration, requirements life cycle management, strategy analysis, requirements analysis, and design definition, and solution evaluation.

Depending on the project, a Business Analyst can have different responsibilities and skills. The most common definition is a Business Analyst is a member of a software development team who analyzes the business domain, elicits requirements, and develops a business model for the developed software products and services.

Usually, ICT high-schools do not pay much attention to BA believing that it doesn't put a value on the education of future programmers. However, when programmers understand BA basic concepts, they will develop their hard and soft skills with increasing competitiveness in the labor market. In this paper, we attack some ideas concerning opportunities to implement the BA approach and techniques for education in the ICT domain.

2. Literature Review

During our review, we discovered a lack of research in both the common BA approach and BA application in education. It means BA is underestimated as a powerful learning tool, and we have the intention to cover this gap in the rest of the paper.

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Some professional editions introducing the profession of business analyst, the common concepts, and the business analysis process. Nowadays this book discusses BA in the context of digital technologies and the role and competencies a modern analyst needs [2]. However, such professional publications do not take into account the needs of high-school education. Quite often, the BA approach is related to the research with financial statement data including business strategy analysis, accounting analysis, financial analysis, and prospective analysis [3].

Another approach in BA-related research is to analyze the institutions using the business anatomy model, to identify the underlying causes of the problems observed [4]. Company analysis is a powerful tool in developing both pieces of research case studies and teaching case studies. Researchers identify the case studies based on company analysis, case studies published by top publishers on company analysis, the difference between research case study and teaching case study, company analysis as a methodology in management research, and effective method of developing research case studies based on company analysis using a framework for a research case study based on company analysis, and the possible recommendations based on analysis [5].

We need to mention also the article presenting a methodological tool for analysis and evaluation of business processes of Ukrainian enterprises [6]. This article proposes a methodology for the identification of "problem" areas of certain business processes by calculating averagely weighted, integral, and generic indicators of efficiency and effectiveness. Assessment of the efficiency and effectiveness of business processes by the specified criteria and indicators allows one to monitor the current activity of the enterprise and evaluate the effectiveness of its operations at every moment.

Most BA publications are devoted to business and entrepreneurship education. The assessed education factors include the following: level of the innovation potential of an enterprise; degree of utilization of the business analysis instruments at the enterprise; level of interconnections between the corporate information systems and business analysis; the needs of the corporate information systems [7]. Some results indicated that a gap does exist between business students' skills/competencies and the needed skills/competencies in the job market [8]. The results of such studies are important for both business educators and employers in bridging the skills gap. The above researchers indicate a gap in business education, but we also can find a gap in ICT education [9].

One of the prospective areas of BA application is different business domain studies, such as banking, e-commerce, e-learning, telemedicine, smart manifesting, etc. As an example, we can mention the safety and security domain [10], when the BA approach supports exercises directed to safety and security assessment and assurance [11].

Also, we include in our review scope researches related to the case method and project-oriented approach. The case method or case study means the analysis of realistic economic, managerial, and other situations (cases) to teach participants certain skills during the discussion of the case, including through the training of other participants [12]. Firstly, the case method was implemented at Harvard Business School in the 1920s [13]. At that time, teachers were faced with the problem of the lack of actual business manuals. The way was found as a description of specific situations from the practice of real companies. The cases as simplified descriptions of problematic business situations were offered to students, and students had to find and substantiate solutions. From the field of business education, the case method was extended to social sciences and STEM (Science, Technology, Engineering, and Mathematics) [14]. Since the 1990-s the case method started to apply in the post-soviet countries. It is worth mentioning a fundamental work "The Case Study Method: Anatomy and Application" [15] published in Kyiv in 2002.

Most of the studies in the area of case method are traditionally devoted to business education [16], and we emphasize on the need for experience transfer from business education to technical education. So, there are not many papers demonstrating case method application for the STEM domain, but between the known papers we pay attention to the few following kinds of research.

The case method is used for teaching an automobile design course at some Chinese colleges [17]. Only some qualitative assessments are provided in the paper. The conclusion is that the case method positively affects students' understanding of the material, creates a positive and creative atmosphere during teaching sessions, and permits the creation of a high-quality interdisciplinary curriculum. Russian studies related to the use of the case method in chemistry have shown an increase in student achievement and professional self-awareness [18], which coincides with the results obtained for entrepreneurial education [19].

There are some empirical studies, which do not confirm the effectiveness of case method application in education. For example, the paper [20] explores hypotheses about the impact of case studies and other teaching methods (lectures and business simulations, which means working with an interactive model of the economic system) on the development of skills such as problem-solving, interpersonal communication, and professional identity. This study shows that business simulation is more effective than the case method from the point of view of developing students' skills.

One more important issue is a set of indicators that are used for case method effectiveness assessment as well as for education effectiveness assessment as a whole. Such indicators include indicators determined by teachers and indicators determined by students [21]. It should be noted that, in our opinion, the assessment of the learning process by students only is quite subjective, since students do not fully possess information about the actual usefulness of the acquired skills and knowledge.

The case method is also used to conduct scientific research in the conditions of the impossibility of collecting data sufficient to perform statistical analysis [22], when, firstly, it is necessary to analyze the object or phenomenon directly in the context of its development, secondly, it is impossible to control the environment in which the object is located or a phenomenon occurs, and thirdly, the number of instances insufficient for static analysis is observed. A comparative analysis of the main approaches to the implementation of the epistemological and methodological aspects of the case method was performed in [23], while the case method allows combining quantitative and qualitative research methods [24]. For example, the cases in the study provide a descriptive representation of three innovative career and technical education programs in energy management and alternative energy programs at the U.S. community college level [25].

Researchers state some important features of Project-Based Learning (PBL), like the following [26]. PBL projects are central, not peripheral to the curriculum, so students learn the fundamentals of discipline via the project. Projects involve students in investigations that provoke the transformation and construction of knowledge. Projects are student-driven and do not end up at a predetermined result since students are provided with more autonomy than usually. The project should be indifferent to usual school exercises. For example, [27] describes a case study devoted to the implementation of software development on the agile base between software engineering students. Results of the case demonstrate the essential improvement in understanding the agile development process. A conclusion is that most students became ready for employment at software development companies.

Survey [28] represents results of applicability analysis of 84 skills related to business analysis. These skills are grouped under soft skills, business, technical, and green parts. Results of the survey discovered that soft skills for business analysts are the most important while business skills are more important than green skills (which include sustainability strategy, management, assessment, and engineering), and green skills are more important than technical skills. It is better to train business and green skills in a postgraduate degree. Some knowledge gap of graduated students has been identified for all four groups of skills.

3. Objective and tasks

Based on the literature review, we recognize some gaps in areas of research related to Business Analysis learning in ICT education. These gaps are in the area of some lack of empirical data as well as a lack of theoretical basis to understand and research the importance of BA in ICT education, to analyze BA methods and exercises from the point of view of the educational task, and to improve the case method and project-based learning related with BA. The objective of this paper is to develop a practical learning framework with the implementation of BA methods in ICT education. To achieve the paper objective, we perform the following research steps:

- Firstly, we analyzed general issues of BA in ICT education;
- Secondly, we defined skillset and methodologies supported with BA learning;
- Thirdly, we screened BA activities and exercises applicable for ICT education;
- After that, we proposed a taxonomy for learning effectiveness indicators related to BA;
- Finally, we develop a practical BA learning framework with the implementation of the case method and PBL.

4. General Issues of Business Analysis Applicable in ICT Education

The BABOK Guide [1] describes knowledge areas for business analysis, as well as tasks and main competencies, techniques, and perspectives concerning BA. The primary purpose of the BABOK is to define the business analyst profession and provide a set of applied practices. The main goal of business analysis is launching positive changes for a company or an institution by defining goals and needs following by value-based recommendations, actions, and solutions.

The core content of the BABOK is composed of tasks organized into six knowledge areas, including BA planning and monitoring, elicitation and collaboration, requirements lifecycle management, strategy analysis, requirements analysis, and design definition, and solution evaluation. The Business Analysis Key Concepts, Underlying Competencies, Techniques, and Perspectives sections form the extended content in the BABOK that helps business analysts to perform their daily duties and activities.

Business Analysis Core Concept Model (BACCM) defines a conceptual framework for the business analyst profession. The six core concepts in the BACCM are: Change, Need, Solution, Stakeholder, Value, and Context. Each core concept is fundamental for the BA performance, and all the concepts are equal and necessary (Fig. 1).

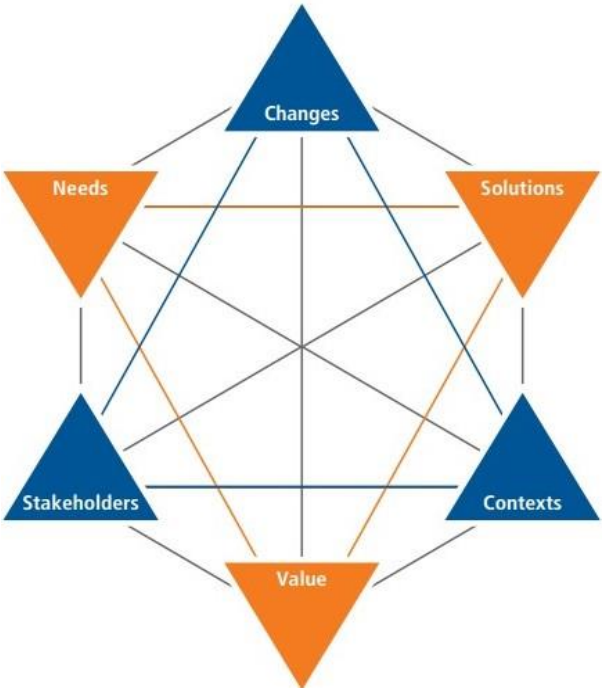

Figure 1: Six-Core Concepts of Business Analysis (source: BABOK Guide)

BABOK provides a list of techniques applicable for requirements analyses and elicitation including benchmarking and market analysis, brainstorming, mind mapping, workshops, business cases, business model canvas, concept modeling, data flow diagrams, interview, focus groups, functional decomposition glossary, interface analysis, process modeling, prototyping, root cause analysis, sequence diagrams, stakeholders' analysis, personas, state modeling, etc.

Each technique description includes a list of stakeholders who probably might participate in the exercise or who could affect or to be affected. The generic list of stakeholders includes the following roles: business analyst, customer, domain subject matter expert, end-user, implementation subject matter expert, operational support, project manager, regulator, sponsor, supplier, and tester. Requirements are considered from the point of view of four groups including Business Requirements, Stakeholder Requirements, Solution Requirements (including both functional and non-functional), and Transition Requirements (see Fig. 2).

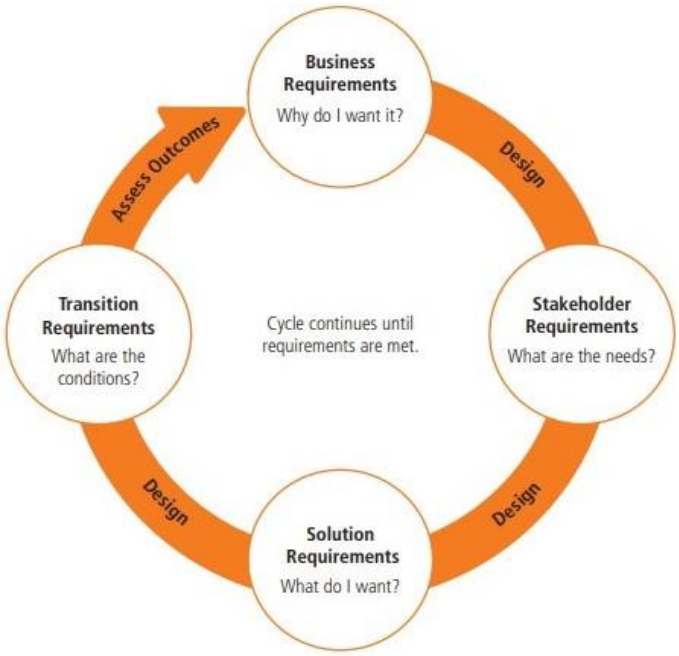

Figure 2: Requirements Groups in Business Analysis (source: BABOK Guide)

5. Skillset and Methodologies Supported with Business Analysis Learning

Reasons for BA learning include its support of the case method approach with PBL as well as the development of students' hard and soft skills (see Fig. 3). BABOK provides evidence that BA learning and training support the development of such hard skillset as analytical thinking and problem-solving, business knowledge, and tools and technical knowledge. Analytical thinking and problem-solving skills are required to identify and define problems, extract key information from data and develop workable solutions for the problems identified to test and verify the cause of the problem and develop solutions to resolve the problems identified. These core competencies include creative thinking, decision making, learning, problem-solving, systems thinking, conceptual thinking, and visual thinking.

Business knowledge is required to perform of understanding on customers" needs and preferences, business environments and their dynamics, staff skills, experiences and potentials, and the business" overall foreseeable direction. Business knowledge underlying competencies include the following: business acumen, industry knowledge, organization knowledge, solution knowledge, and methodology knowledge.

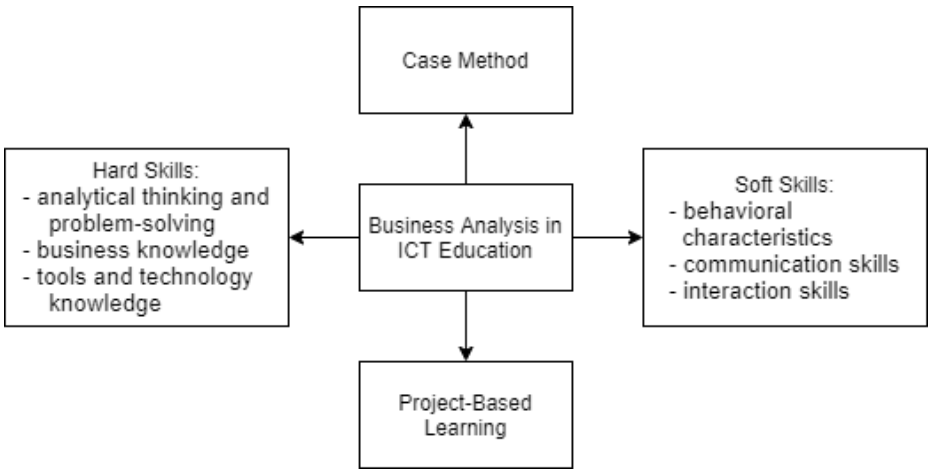

Figure 3: A Concept of Business Analysis implementation to enforce ICT Education

Tools and technology core competencies include knowledge of the following: office productivity tools and technology, communication tools and technology, and, what is the most important, business

analysis tools and technology. The last category supports such capabilities as the following: modeling, diagramming, documenting, analyzing, and mapping requirements, identifying relationships between requirements, tracking and storing requirements artifacts, and communicating with stakeholders.

Modeling tools can provide functionality that assists business analysts with several modeling related tasks, including creating models and visuals to help align stakeholders and outline the relationship of needs, entities, requirements, stakeholders, and context; tracing visuals to business rules, text requirements, scope statements, scope visuals, data requirements, product needs, and other requirements context and information; and creating an executable for a proprietary engine to execute the model or generate an application code which can be enhanced by a developer. These tools frequently validate compliance with the notation. Some modeling tools support the creation of executable models, such as business process management systems, which allow for the creation of executable process models, and business rules management systems, which allow for the evaluation of captured business rules.

Requirements management technologies can provide functionality that assists business analysts with several requirements management related tasks including requirements workflow including baselining, approvals and sign-off, change control, and implementation status; traceability including backward traceability forwards traceability; relationships between requirements, and impact analysis of requirements change; configuration management of requirements and requirements artifacts; and verifying the quality of requirements through checking for defined characteristics and relationships.

Issue tracking tools can provide functionality that assists business analysts with some issues tracking related tasks such as tracking requirements risks, tracking requirements conflicts and issues, and tracking defects. Prototyping and simulation tools can provide functionality that assists business analysts with prototyping or simulating the solution or pieces of the solution.

Concerning soft skills, BABOK presents the following three categories: behavioral characteristics, communication skills, and interaction skills. So, all these skills can be trained during BA exercises performed by students. Behavioral characteristics have been found to increase personal effectiveness in professional practice. These core competencies include ethics, personal accountability, trustworthiness, organization and time management, and adaptability. Communication skills core competencies include verbal communication, non-verbal communication, written communication, and listening. Interaction skills core competencies include facilitation, leadership and influencing, teamwork, negotiation, and conflict resolution, and teaching.

We agree with many advantages of case method application for education such as orientation to students' individuality, development of entrepreneurial and managerial skills as well as problem-solving abilities and critical thinking, increasing motivation for learning, active involvement in the educational process, getting experience of teamwork and communication, decision making in conditions of stress and uncertainty. From this point of view, BA provides many advantages, since most parts of BA exercises are industrial cases. The BA case can support students' hard skills development in engineering through requirements analysis, elicitation, and management.

On the other hand, engineering hard skills can be developed with the PBL approach supported by BA. PBL is aimed at training students to use the acquired knowledge and skills, and most importantly to be able to solve real professional tasks. Project training usually runs in parallel with the main schedule and helps students transfer knowledge and skills from classes to the real work environment in which they plunge during the project activity. The advantages of PBL are very similar to the advantages of the case method. There is active and creative learning of students, facing real life and real professional work, a positive impact on student motivation, training in teamwork skills, project management, and BA. At the same time, it is a huge challenge for students and teachers, which can be pretty unusual and hire extra effort.

6. Business Analysis Activities and Exercises Applicable for ICT Education

In general, there are the following main activities performed by business analysts during IT projects running:

- Pre-sales which include activities related to preliminary negotiation with a potential client communicating him generic information about future project scope and price;

- Discoveries which include an initial project phase related to elicitation, analyzing, and documenting of requirements with the execution of different kinds of BA exercises (see Table 1);
- The main project activities are usually managed under agile methodologies including backlog prioritization and grooming with communicating requirements to the project team and organizing User Acceptance Tests to get feedback from stakeholders;
- Internal company activities directed business processes management and improvement of the company processes which can be described, for example, in a view of Business Process Modeling Notation (BPMN) diagrams.

Table 1
Business Analysis exercises for ICT education

Name	Description	Applicability	Priority
Desk research	Get general knowledge about domain and project	Learn general issues in the domain	Medium
Project context diagramming	Context diagrams are visual tools that depict the scope of the product	Learn how to establish product and project borders and interfaces	Medium
Stakeholder analysis	Assessing a system and potential changes to it as they relate to relevant and interested parties	Learn how the interests of stakeholders should be addressed in a project plan, policy, program, etc.	Medium
Interview with stakeholders	A structured conversation where participants ask a question and get an answer	Learn how to get important information during a conversation	Low
Market research	Discover market trends and competitors' actions and practices	Learn market, competitions, and risks to get commercial perspectives	Low
Personas	and design of all the audience users	Make decisions concerning the users' experience	High
Customer journey mapping	Creation of a visual story of customers' interactions with the brand	Learn influential channels and touchpoints and how can you impact these	High
Business process modeling	Representing how the current process may be improved or automated	Learn how to improve process points like speed, time, cost, etc.	Medium
Design of information architecture	Structural design of shared information environments including websites	Classify the content in a clear and understandable way	High
Project prioritization	Define project scope, road map and put priorities	Learn how to build a minimum viable product	Medium
High-level architecture modeling	Explains the architecture that would be used to develop a system	Draw the diagram that provides an overview of an entire system identifying the main components	Medium
Third-party integration analysis	Extension of external data using APIs (Application Program Interfaces)	Check which existing APIs can be used to simplify the design	Medium
Database structure modeling	Ensures that all data objects required by the database are accurately represented	Draw the Entity-Relationship diagram	Medium

The discovery stage is relatively independent of the business environment and can be established for students separately from the full scope of the real project. If students are involved in the real live project, they can perform discovery activities depending on their skills and abilities. Secondly, discovery includes most exercises and cases which students can perform one by one. We analyzed typical exercises which ICT companies perform during the discovery phase. The results are presented in Table 1, including the following: name of exercises, description of exercises, the applicability of exercises for the education of students, the priority of exercises used for the education of students (high, medium, or low).

A list of BA exercises in Table 1 is not comprehensive and may be extended depending on the curriculum. For example, the focus for the software engineering curriculum can be displaced to details of the design of high-level architecture, third-party integration analysis, or the design of a database. BA exercises with high priority including personas method, customer journey mapping, and design of information architecture are the most applicable for ICT education. Priorities also can be updated depending on specific objectives of the learning course program.

7. Taxonomy of Learning Effectiveness Indicators related to Business Analysis

We proposed three-level taxonomy of E-learning effectiveness indicators in [9]. This taxonomy is a good starting point to analyze the known empirical researches, but also the taxonomy can be enriched by the results of new experiments.

Researches, which are analyzed above in this paper, deal mainly with the education performance indicators defined by teachers and students in the learning process. It should be noted that assessment of the learning process by students is quite subjective since students do not fully possess objective information about the actual usefulness of the acquired skills and knowledge. The same applies to some extent to teachers. Complaints about the lag of teachers' experience from industrial daily life's realities are justified in many cases (Table 2).

Therefore, if teachers are working in the framework of the curriculum only, they can also not always fully appreciate the objective usefulness of the knowledge and skills taught. Therefore, in our opinion, it is necessary to take into account two more important categories of indicators. The first category is effectiveness indicators determined by graduates during some time after the end of graduation, and the second category is effectiveness indicators determined by the employer. A challenge is to take valid and relevant data to estimate these kinds of indicators, but modern online technology can help to resolve this issue. We also put in the taxonomy some metrics related to the application of the Learning Management System (LMS), since LMS is a centralized environment for administration, documentation, tracking, reporting, and delivery of learning courses [29]. In the actual paper, we updated the existing taxonomy with specific BA learning indicators. The main ideas to develop BA-specific indicators can be taken from the skillset that is already described in the paper. Concerning students' hard skills development, we consider the BA analytical thinking and problem-solving, business knowledge, tools and technical knowledge. The same approach we use to provide soft skills-related metrics, which cover abilities to follow BA learning as well as behavioral, interaction and communication characteristics.

Input data for indicators application can be taken from different kinds of surveys organized as a part of experimental researches. It is worth to design experiments by the way which would allow to figure out some changing of indicators' value during the time of observation.

Measurement of indicators taken from opinions of graduates or employers is not typical for such kinds of surveys. However, it is dramatically important to learn both groups of stakeholders since they are the main consumers of education results. A motivation to includes graduates and employers to survey is explained as opportunity to understand longtime results of obtained knowledges and skills. Such information clarifies a real value of educational programs. A correlation between teachers/students indicators and graduates/employers indicators could be a subject of future research.

Table 2
Taxonomy of learning effectiveness indicators related to Business Analysis

Stakeholder who defines indicators	Group of indicators	Example of indicators
Teachers	Students' knowledge assessment	Performance assessment metrics
		Analytical thinking assessment
		Problem-solving assessment
		Knowledge business assessment
		Modeling tools application metrics
		Requirements management technologies application metrics
		Issue tracking tools application metrics
		Prototyping and simulation tools application metrics
		Results of the passing of tests and exams
		General results of studies at the university
	Students' soft skills assessment	Soft skills assessment metrics
		Abilities to follow BA learning
		Behavioral characteristics assessment
		Communication skills assessment
		Interaction skills assessment
	Self-assessment	Abilities to drive BA learning
		Satisfaction with BA learning
	Process and LMS assessment	Process and LMS assessment metrics
Students	Self-assessment	Abilities to follow BA learning
		Satisfaction with BA learning
	Process and LMS assessment	Process and LMS assessment metrics
	Teachers' assessment	Abilities to drive BA learning
	The influence on the development of competencies	Influence on the theory understanding
		Influence on the development of hard/soft skills
	Opportunities of applying the competencies in practice	The influence on the development of hard/soft skills
Graduates	Degree of satisfaction with the former educational process	Quality of the working environment
		Salary
	Opportunities of applying the competencies in practice	The influence on the actual hard/soft skills
Employers	Satisfaction with the employees' results	Key Performance Indicators (KPIs)
		Salary

8. Business Analysis Learning Framework with Case Method and Project-Based Learning

An integral part of this research joins all outputs in a view of the BA learning framework supported with the case method and PBL. This framework is presented in Fig. 4. Below we briefly discuss the main parts of the framework. PBL principles are related to the approach to choose and drive the project as the core practical activity of the course. We adopt the approach proposed in [26] with the following principles:

- Projects are the central item of the course and the central teaching strategy because students learn the course via the project;
- Projects involve students in a special kind of investigation directed to knowledge construction and transformation;
- Students play the main role in project performance, and projects are realistic.

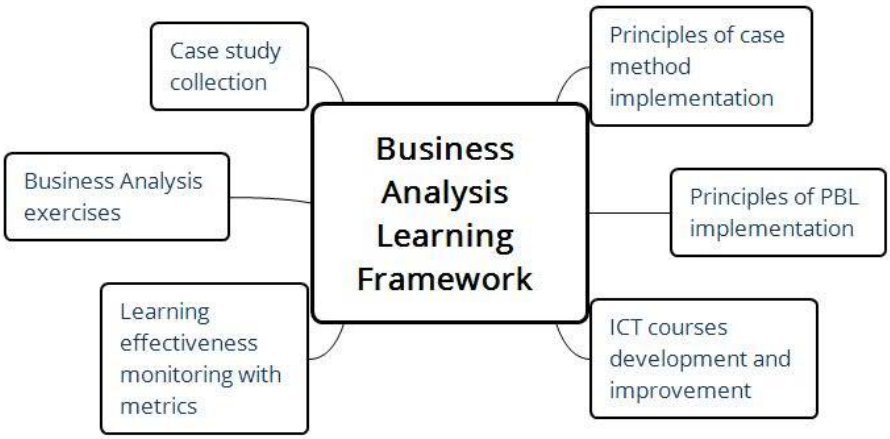

Figure 4: A structure of the BA learning framework supported with case method and PBL

Principles of case method implementation are closely related to the PBL approach. The main idea is to propose for students a real software-hardware product and real documents covering the needs and approaches of BA. Successful case method implementation suggests consideration of all best practices related to PBL. More support for the case method and PBL can be done with the right organization of students' homework [30]. This includes supplying students with all materials and instructions. Principles of homework are the following: a collection of online materials in the LMS area; combination, depending on the material being studied, of various forms of homework (such as classroom individual or group study, extracurricular individual or group study); student-centered approach with the formation of an individual trajectory of the education and homework depending on the individual preferences of students and the recommendations of teachers; focus aimed at the development of creative and research competencies; monitoring by the teacher to analyze the adoption of learning material by students; analysis of the opportunities to improve the homework process; taking into account curriculums of other interrelated academic courses.

ICT courses development and improvement bases on using modern design tools and LMS. A modern approach to e-learning implementation consists of the development of massive open online courses (MOOCs) [31]. Other MOOCs related issues lay in student feedback monitoring and continuous improvement. For learning effectiveness monitoring teachers should choose a set of appropriate effectiveness indicators. An example of taxonomy is presented in Table 2. Results of effectiveness monitoring are outputs of a case study organized to supply stakeholders with relevant empirical data. Periodical field review can be a method to implement a case study. Also, other relevant case studies can be included in data collection to support case meta-analysis. BA exercise base (see Table 1) should be updated periodically to provide a set of state-of-the-art cases [1].

9. Conclusions

In this paper, we obtain the following results. General issues of the BABOK Guide [1] have been analyzed. The core content of the BABOK is composed of business analysis tasks organized into six

knowledge areas, including BA planning and monitoring, elicitation and collaboration, requirements lifecycle management, strategy analysis, requirements analysis and design definition, and solution evaluation. Business Analysis Core Concept Model (BACCM) defines a conceptual framework for the business analysis profession. The six core concepts in the BACCM are: Change, Need, Solution, Stakeholder, Value, and Context.

Reasons for BA learning include its support of the case method approach with PBL as well as the development of students' hard and soft skills. BABOK provides evidence that BA learning and training support the development of such hard skillset as analytical thinking and problem-solving, business knowledge, and tools and technical knowledge. Concerning soft skills, BABOK presents the following three categories: behavioral characteristics, communication skills, and interaction skills. So, all these skills can be trained during BA exercises performed by students. In general, we can conclude, BA learning supports a design thinking mindset, which is dramatically important for modern software and computer engineers.

Discovery activity is the most important for BA learning. This stage is relatively independent of the business environment and can be established for students separately from the full scope of the real project. If students are involved in the real live project, they can perform discovery activities depending on their skills and abilities. BA exercises with high priority including personas method, customer journey mapping, and design of information architecture are the most applicable for ICT education. Priorities also can be updated depending on specific objectives of the learning course program.

Taxonomy for indicators of BA learning effectiveness is proposed. This taxonomy contains three the following levels: stakeholder who defines indicators including teachers, students, graduates and employers, group of indicators and single indicators. Finally, we develop a practical BA learning framework with the implementation of the case method and PBL, which includes the following entities: principles of case method implementation, principles of PBL implementation, principles of homework organization, ICT courses development and improvement, BA learning effectiveness monitoring, BA exercises, and case study collection. The practical value of the paper is determined by the development of a framework for effective BA learning implementation based on the principles of PBL and the case method. A theoretical novelty of the paper lies in a technique of BA learning effectiveness analysis supported with practical recommendations on how to implement it in ICT education.

However, this is a start point, when we set some hypotheses related to BA learning effectiveness. To confirm it, we need to organize some case studies to be able to obtain new experimental data. Appropriate questionnaires design and distribution between teachers involved in ICT education can be the next step of the research.

10.References

[1] BABOK v3. A Guide to the Business Analysis. Body of Knowledge. International Institute of Business Analysis (2015).

[2] F. Milani, Digital business analysis. Springer International Publishing (2019).

[3] K. Palepu, P. Healy, S. Wright, M. Bradbury, J. Coulton, Business analysis and valuation: Using financial statements. Cengage AU (2020).

[4] A. Elsafty, H. Sayad, I. Shaaban, A business analysis perspective for engineering education in Egypt. J. of Education and Training Studies, 8(5), 30-42 (2020).

[5] P. Aithal, An effective method of developing business case studies based on company analysis. Int. J. of Engineering Research and Modern Education, 2(1), 16-27 (2017).

[6] A. Cherchata, I. Popovychenko, U. Andrusiv, L. Simkiv, O. Kliukha, O. Horai, A methodology for analysis and assessment of business processes of Ukrainian enterprises. Management Science Letters, 10(3), 631-640 (2020).

[7] A. Komarova, L. Tsvetkova, S. Kozlovskaya, N. Pronkin, Organisational educational systems and intelligence business systems in entrepreneurship education. J. of Entrepreneurship Education, 22(5), 1-15 (2019).

[8] K. Alshare, M. Sewailem, A Gap Analysis of Business Students' Skills in the 21st Century: A Case Study of Qatar. Academy of Educational Leadership J., 22(1), 1-22 (2018).

[9] V. Sklyar, V. Kharchenko, Case-Based and Project-Based Methods for Effective E-learning in ICT Safety and Security. In: Proceedings of the 16th International Conference on ICT in Education, Research and Industrial Applications (ICTERI 2020), 2, pp. 157-170, Kharkiv (2020).
[10] V. Sklyar, V. Kharchenko, Fault-tolerant computer-aided control systems with multiversion-threshold adaptation: Adaptation methods, reliability estimation, and choice of an architecture. Automation and Remote Control, 63(6), 991-1003 (2002).
[11] V. Sklyar, V. Kharchenko, Assurance Case Driven Design based on the Harmonized Framework of Safety and Security Requirements. In: Proceedings of the 13th International Conference on ICT in Education, Research and Industrial Applications (ICTERI 2017), pp. 670-685. Kyiv (2017).
[12] J. Escartína, O. Saldañaa, J. Martín-Peñab, A. Varela-Reya, Y. Jiméneza, T. Vidala, Á. Rodríguez-Carballeiraa, The impact of writing case studies: Benefits for students' success and well-being. Procedia – Social and Behavioral Sciences, 196, 47-51 (2015).
[13] S. Schmidt, Case Studies and Activities in Adult Education and Human Resource Development. Information Age (2010).
[14] P. Sturko, J. Gregson, Learning and Collaboration in Professional Development for Career and Technical Education Teachers: A Qualitative Multi-Case Study. J. of STEM Teacher Education, 45(3), 34-60 (2008).
[15] Yu. Surmin (ed), The Case Study Method: Anatomy and Application. Center for Innovations and Development (2002).
[16] S. Sanders-Smith, T. Smith-Bonahue, O. Soutullo, Practicing teachers' responses to case method of instruction in an online graduate course. Teaching and Teacher Education, 54(1), 1-11 (2016).
[17] L. Jiao, A Brief Analysis of Application of Case Method of Instruction in Automobile Design Course Teaching. Advances in Social Science, Education and Humanities Research 96, 245-249 (2017).
[18] A. Derkach, Case-study method in teaching organic chemistry: compilation and use of tasks. Secondary vocational education, 11, 45-47 (2010).
[19] M. Pilz, L. Zenner, Using case studies in business education to promote networked thinking: findings of an intervention study. Teaching in Higher Education, 23(3), 325-342 (2018).
[20] M. Farashahi, M. Tajeddin, Effectiveness of teaching methods in business education: A comparison study on the learning outcomes of lectures, case studies and simulations. Int. J. of Management Education, 16(1), 131-142 (2018).
[21] B. Heather, H. Clara, E. Noelle, C.-R. Mine, Understanding the massive open online course (MOOC) student experience: An examination of attitudes, motivations, and barriers. Computers & Education, 110, 35-50 (2017).
[22] H. Harrison, M. Birks, R. Franklin, J. Mills, Case Study Research: Foundations and Methodological Orientations. Forum: Qualitative Social Research, 18(1) (2017).
[23] B. Yazan Three Approaches to Case Study Methods in Education: Yin, Merriam, and Stake, The Qualitative Report, 20(2), 134-152 (2015).
[24] R. Yin, Case study research: Design and methods. Sage (2014).
[25] J. Gregson, K. Ruppel, Career and Technical Education for Sustainability: A Multiple Case Study of Innovative Community College Programs. J. of Research in Technical Careers 1(2), 15-25 (2017).
[26] J. Thomas, A review of research on project-based learning. The Autodesk Foundation (2000).
[27] P. Gupta, A. Saini, Agile Software Projects Implementation in technical education for Learners – A Case Study. In: Proceedings of the International Conference on Sustainable Computing in Science, Technology & Management (SUSCOM-2019), 763-769. Jaipur (2019).
[28] D. Richards, M. Marrone, Identifying the education needs of the business analyst: an Australian study. Australasian J. of Information Systems 18(2), 165-186 (2014).
[29] V. Chang, C. Gütl, M. Ebner, Trends and opportunities in online learning, MOOCs, and cloud-based tools. In: Second Handbook of Information Technology in Primary and Secondary Education, 1-19. Springer (2018).
[30] Z. Ozdilek, S. Okumus, K. Doymus, The effects of model supported cooperative and individual learning methods on prospective science teachers' understanding of solutions. Journal of Baltic Science Education, 17(6), 945-959 (2018).

[31] M. Gruzdeva, O. Vaganova, S. Kaznacheeva, N. Bystrova, A. Chanchina, Modern Educational Technologies in Professional Education. In: Popkova E. (eds) Growth Poles of the Global Economy: Emergence, Changes and Future Perspectives, pp. 1097-1103. Springer (2020).