

**Summary of the doctoral dissertation written under the supervision of
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**KNOWLEDGE MODELING
FOR INDIVIDUAL HIGHER EDUCATION PROFILE FORMATION**

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Within the last ten years, higher education in the whole world has undergone significant changes. They were caused, among others, by governments introducing new regulations to which higher education institutions (HEI) had to adapt and were also initiated by the HEIs themselves since they see the necessity of introducing changes and improvements to stay competitive and attractive for the potential students. Also, the students are constantly raising their demands for educational institutions. They want to be actively engaged in the education process development, to have their opinions and preferences considered, and to build their educational path themselves only of the best practices. Students' Individual Higher Education Profiles commonly include the gained knowledge and skills (hard and soft), practical experience, scientific achievements, and the whole "baggage" students obtain during their studies. For educational institutions, one of the ways of increasing the quality of education is introducing the personalized approach towards the formation of Students' Individual Higher Education Profiles. Such a personalized approach may include: allowing the students to participate in study programs development, offering tutorship and/or mentorship programs for their professional and personal development, letting them have flexible course schedule, emphasizing practical classes and workshops, motivating them, and many more. Therefore, *the primary object of this research* is the process of personalization of education, within which the students are offered a possibility to form their Individual Higher Education Profiles.

The author aims to make cognitive, methodological, and practical contributions towards a better understanding of 1) how students see the personalization of higher education, 2) what HEIs already do and should do to provide students with the personalized approach, and 3) how one can assess personalization and measure its level. The author sets *the main research hypothesis of this work*: development of a knowledge model of didactic, research, and administrative processes running at higher education institutions, in the form of a maturity model, will allow for assessment of the level of personalization of students' education and will provide educational institutions with clues on personalization policy improvement. To prove this hypothesis, the author sets the *ten objectives to be achieved with this research*.

Cognitive objectives:

1. Critical review of the education personalization policy at HEIs.
2. Critical review of the maturity models and frameworks developed for HEIs.
3. Review of the existing knowledge modeling methods, particularly those applied for issues connected with higher education.
4. Identification of the subprocesses within the didactic, research, and administrative processes, connected with personalization of education and student's Individual Higher Education Profile formation.
5. Investigation of students' attitude towards personalization of education.
6. Development of the method of assessment of the level of personalization of education.

Methodological objective: enrichment of the contemporary research methods with proposals for:

- 1) an approach to the didactic process analysis – application of the process modeling notation;
- 2) an innovated approach to the assessment of personalization of education – application of the maturity model, developed taking into consideration students’ preferences and expert opinions of HEIs’ teaching and administrative staff.

Practical objectives:

1. Building the models of tasks and subprocesses within the didactic, research, and administrative processes, which are connected with personalization of education and Individual Higher Education Profile formation – with the application of the process modeling notation.

2. Development of a model of maturity of personalization of education to be applied at HEIs to assess the current situation with the Individual Higher Education Profile formation.

All these objectives are defined to contribute to the realization of *the major objective of the dissertation*: to extend the management system of HEIs with the method for analysis, assessment, and improvement of the current personalized approach towards students’ educational and other activities. Additionally, *eleven research questions* are set (and answered) in the dissertation to support the execution of the major objective.

The research work is conducted with regard to *the Design Science Research (DSR) framework*. The dissertation is divided into *three major parts*. *In the first part (chapters 1- 3)*, the author conducts a comprehensive literature review in the domain of higher education to identify and analyze the principles of students’ Individual Higher Education Profiles formation, the existing approaches to the development of maturity models for higher education institutions, and the methods of modeling knowledge for HEIs. *In the second part (chapters 4 and 5)*, the author presents the models of the processes flowing at higher education institutions (on the example of one particular HEI) using the Business Process Model and Notation (BPMN) methodology, and the Education Personalization Maturity Model (EPMM). *In the third part (chapter 6)*, the author presents the process and results of verification of the developed EPMM Model and identifies the weaknesses and strengths of the personalization policy of 51 HEIs.

In chapter 1 literature review is conducted to determine: what are the experiences of HEIs in the process of personalization of education; what aspects within the education, research, and administrative processes of HEIs require a personalized approach; and which term (personalization, individualization, or customization) would be the most accurate and unambiguous to describe the personalized approach towards students’ education (in the context adopted in this dissertation). The review allows revealing that: 1) the majority of papers, identified as a result of the search with the keyword “individualization”, is focused on the Individualized Education Program for students with disabilities, or to the individualized approach to specific education of patients with severe illnesses; 2) in many studies, customized education is associated with the one conducted according to the job requirements provided by partner business units; 3) personalization of education is mainly related to educational choices and value of students’ personal differences; 4) the most frequently addressed aspects that students of HEIs consider essential in the process of their educational path formation are: relevance of the field of study, the possibility of master’s studies at the same institution, individual approach, quality of teaching, location and infrastructure, job opportunities after graduation, possibility of studying in a foreign language and/or abroad, active usage of technologies in class and more practical tasks during the classes. In this chapter, the author provides proof of the fact that “personalization” of education is

the most unambiguous term to use to describe the HEIs' personalized approach towards student's Individual Higher Education Profile formation.

Chapter 2 also contains a literature review, which provides answers to the questions: what maturity models for HEIs have been developed in the past ten years; have any maturity models for the assessment of education personalization been developed within the past ten years; and what the constructs of a maturity model are. The author identified 13 maturity models developed to analyze and support e-learning, assessment and planning of the learning process, and other valuable processes. The review reveals the existing gap in maturity models development for higher education. No maturity model has been developed so far to help assess and improve the personalized approach of HEIs towards their students. This allows the author to assume that this gap could be filled with the Education Personalization Maturity Model.

Chapter 3 contains a review of literature, performed to find out: what methods of knowledge modeling are used in the up-to-date research works; what methods of knowledge modeling are implemented for HEIs; whether the methods of modeling, applied by the author in the work, can be referred to as knowledge modeling methods. The knowledge modeling methods most frequently implemented for HEIs, are the ontological approach and concept mapping. Other popular methods (regardless of the application area) are knowledge mapping, graph-based modeling, and maturity models. With reference to the description of knowledge modeling as a whole, of knowledge modeling methods, and of the types of modeling that generally exists, the author justifies the choice of the three knowledge modeling methods that are applied in the dissertation: concept mapping, business process modeling, and maturity model development.

In *chapter 4*, the author proceeds to the practical part of the work. *The research subject of this particular chapter* is the University of Economics in Katowice. On the example of this HEI, the author builds a landscape of processes that run at HEIs. In this landscape, the processes are divided into three categories: core, management, and support processes. These process categories are subject to identification and delimitation. The author distinguishes 20 processes that contribute to education personalization, and further, these processes also pass *the identification and delimitation stage*. *The Business Process Model and Notation diagrams* for each process are built. This allows revealing particular tasks performed in these processes and analyzing whether any of these tasks play a role in personalization development. After this thorough analysis supported by BPMN models, the author selects 19 processes and 52 subprocesses and tasks, stating that this set is most directly connected with the personalized approach towards students. The quality of these processes and tasks realization should be of a high level.

Chapter 5 presents the Education Personalization Maturity Model (EPMM), developed by the author for assessment of the level of HEIs' personalized approach towards their students. *The objective of the EPMM development* is twofold: identification of the practices related to the personalization of education at HEIs and creation of the assessment methodology of the quality of these practices' realization. In the process of EPMM development, the author uses the following sources of information: studies on maturity models, especially those developed for educational institutions (from chapter 2); design decisions developed by T. Mettler¹ (discussed in detail in chapter 5); resolutions, ordinances, regulations, and other official documents of the University of Economics in Katowice (from chapter 4); processes, running at the University of Economics in

¹ T. Mettler, 'Thinking in Terms of Design Decisions When Developing Maturity Models', *Int. J. Strateg. Decis. Sci.*, vol. 1, no. 4, pp. 76–87, 2011.

Katowice, connected with the personalization of education (modeled in chapter 4); opinions of students of the University of Economics in Katowice, obtained through a questionnaire survey (chapter 5).

The questionnaire survey is aimed at finding out the students' opinions and preferences about specific issues connected with education at their HEI and with the personalization of education. The total number of responses obtained is 284. The time scope of the survey is October 2019 – April 2020. Almost 50% of respondents at that moment studied at the University of Economics in Katowice. The questionnaire contains 53 questions: 50 of them are given in the form of statements, for which the respondents had to select a grade from 1 to 5 (Likert scale), expressing their attitude to the suggested option, and the remaining three questions are open-ended. The questionnaire allows distinguishing a set of personalization practices performed by HEIs, that are most preferable for students. These practices are categorized into four groups: online services for students (for instance, schedule, course grades, forms to register on exchange programs); courses and study programs that HEIs offer to their students; possibilities of conducting research activity; other practices that do not fit any of the previous three groups.

These four groups serve as the basis for the formation of four Key Process Areas of the Education Personalization Maturity Model, which are: "Students' Platform", "Courses and Fields of Study", "Research Activity", and "Extracurricular Activities". These Key Process Areas contain 34 Practices related to education personalization. It is suggested to assess the personalization maturity by five Levels: not assessed (zero level; no personalization practices realized), initial (or ad hoc), repeatable, defined & managed, and optimizing. The practices contain descriptions of five Cases, each referring to a certain Level of personalization maturity. Each Case is, in other words, a situation suggested to occur at the analyzed HEI; the higher the maturity level, the more expanded the description of the Case is, i.e., the more advanced personalization of education is observed at the selected HEI.

The objective of EPMM development is realized by the structure of the EPMM (Key Process Areas with Practices; Cases inside Practices) and also by the procedure of analyzing these Cases to define a particular level of personalization maturity of a HEI.

Chapter 6 presents the process of verification of the Education Personalization Maturity Model. As the verification method, the author selected the questionnaire survey, which was realized in two stages. At the first stage, ten experts from Polish and German educational institutions were asked to assess the structure of the EPMM Model and to state whether its statements are clear and whether it covers most of the aspects connected with education. At the second stage, the respondents were the representatives of the teaching, research, administrative, and management staff of 51 higher education institutions from 25 countries in Europe (68%), Asia (16%), South America (12%), and Africa (4%). They were asked to assess the level of personalization at their HEIs using the EPMM model, improved after the first stage. One respondent from each institution was selected, which resulted in obtaining 51 completed questionnaires. Poland was represented by 14 HEIs. The survey was conducted in the period from May to July 2021, and the questionnaire was distributed via Google Forms. The K-means clustering, and Spearman's rank-order correlation methods were used to draw specific conclusions about the situation related to the personalization policy at the studied 51 HEIs. They revealed the common strengths and weaknesses regarding the personalized approach towards their students in the identified clusters of institutions.

The author distinguishes *the cognitive, methodological, and practical contributions* of this dissertation. *The main cognitive contribution* consists in creating a list of processes and tasks performed at HEIs, that influence the development of the personalized approach of HEIs towards their students during the process of the Students' Individual Higher Education Profiles formation. *The secondary cognitive contribution* consists in the extension of understanding of the common strengths and weaknesses of the analyzed 51 HEIs as for the options of personalization of education they provide for their students. *The methodological contribution* consists in the approach, based on the Education Personalization Maturity Model, that would facilitate the enhancement of personalization policy. *The main practical contribution* is the EPMM developed to assess the level of personalization of education at HEIs. *The secondary practical contribution* consists in using two knowledge models (a business process model and a maturity model) for structuring the knowledge about didactic, research, administrative, and management processes that run at higher education institutions and result in the development of a personalized approach towards students.

Research carried out in this dissertation leads to a conclusion that higher education institutions, represented by their administrative and management staff, may benefit from the application of the Education Personalization Maturity Model presented in the work. Implementation of the EPMM enables the assessment of the level of personalized approach that higher education institutions provide for their students and also provides suggestions on possible ways of improving the current level of the personalization of education.

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