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(Business Process) Models from an Educational Perspective

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1 Background and Motivation

A vast amount of scientific research and literature is devoted to business process models. The spectrum includes languages, style, quality, analysis, simulation methods, tool support, and even further aspects. However, most of this work only considers business process models from an industrial perspective: the ultimate goal is to support organizations and companies through the development, use and implementation of process models. But as business process modeling, or even more generally modeling itself, has become an integral part of many programs in higher education institutions and universities, we have identified yet other challenges and usage opportunities for research with regards to models in the context of modeling education.

Year by year during our university courses concerned with modeling, a growing number of students creates models in exercises and exams. Each semester we struggle with handling and grading these big yet analogous datasets with hundreds of modeling solutions for, e.g., business processes and ER-diagrams. However, a manual correction and grading procedure is usually a time-consuming and error-prone task. Also, the consistent application of a predefined grading scheme is hard to enforce. Currently we often distribute the correction of exam questions so that only one person is responsible for one question to increase consistency while trying to be as efficient as possible. However, we still detect inconsistent or even erroneous corrections.

In the age of growing digitization and Massive Open Online Courses (MOOCs) many universities start integrating IT support into the academic processes, e.g., by offering e-assessments [6]. As opposed to written exams or tests, in an e-assessment students create digital solutions using a software tool so that the results can be analyzed (semi-)automatically. Thus, having models in digital form rather than handwritten on a sheet of paper opens up new opportunities for the educational context. First, an **automation of the exam correction process** enables an efficient and consistent grading. Secondly, we can conduct what is widely denoted with the buzzword **Learning Analytics** [3]. The results of automated analyses can be easily aggregated over large sets of models to, e.g., detect the most common mistakes. This in turn allows us to draw conclusions about the underlying teaching concept and can be used to improve university courses. With this article, we aim to illustrate those opportunities.

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2 Towards a Technical Implementation

To enable an automated approach for processing digital process models, those should not only be digitized as an image or photograph, but encoded in a formal representation which allows an easy and straightforward access to all model elements for a subsequent analysis. An example is the Petri Net Markup Language (PNML)¹ which serves as an XML-based interchange format for Petri nets. Regarding the educational context, a fundamental decision has to be made about the model creation process. Should students enter their models with a modeling tool including modeling support or rather without any intelligent features? If we want to determine the learning outcome of our students, it might be counterproductive to have the modeling tool help them with the creation of correct models (e.g., by not allowing to draw arcs between nodes of the same type in Petri nets). Thus, in an exam setting we need (i) modeling tools without modeling restrictions or support as well as (ii), an interchange format which explicitly allows a representation of incomplete and incorrect models.

Quality assessment of conceptual models has been described extensively in the scientific literature (e.g. [4,5]). Also, guidelines have been proposed on how to create models which can be easily understood. As models are primarily interpreted by humans, the importance of this factor has been stressed many times. Despite these efforts, we witness that during exam corrections, the models created by students are mostly checked in terms of syntactical and semantical correctness without considering other relevant aspects like pragmatic quality, e.g., understandability of the model or the compliance to modeling guidelines. Hence, we want to accentuate the need for defining more suitable learning objectives and quality criteria for models created in an educational context. On the basis of a digital interchange format, several algorithms towards a quality measurement could be implemented. E.g., checking the compliance with modeling guidelines or determining the degree to which certain quality criteria are fulfilled. Even the semantic quality, which describes the degree to which a model is compliant to real-world facts, can be determined automatically by comparing a model to a digital representation of such real-world facts, e.g., in form of an ontology. Altogether, these algorithms can support the correction and grading process. Even if not all necessary steps can be performed automatically, the number of tasks to be performed manually is expected to decrease drastically. Also, to support learning analytics, it could be feasible to detect single aspects in models responsible for common mistakes, which might be addressed in future lectures.

Automatic clustering of models might help to investigate common mistakes in exams. As it takes a lot of effort to manually investigate errors in hundreds of exam solutions, these data are only rarely used to identify common mistakes which should be addressed in a corresponding lecture to improve the learning outcomes. An automatic clustering could be used to point out such mistakes through the

¹ http://www.pnml.org/

identification of similar models. I.e., we assume that similarity and clustering techniques for models can be adapted so that it is possible to identify clusters in which models contain the same error. Another application of clustering could be during the correction phase of an exam. According to our experiences, some mistakes are frequently made by students, which should be graded consistently. Yet, this is difficult to achieve with hundreds of solutions as a corrector usually has to keep track of certain errors and their grading scheme. In this context, clusters of similar solutions might speed up this process besides increasing the consistency of corrections as each cluster could be corrected at a time. Suitable techniques might be process matching and similarity approaches (e.g. [1,2]), which could be adapted to the education context.

3 Outlook

Our next goal is the setup of a platform to manage, organize and analyze large collections of digital process models. Analysis algorithms will be added step by step. A key element of the platform is the possibility to arrange quality criteria flexibly by choosing relevant algorithms and weighting their individual outcome according to the requirements. Plus, it is possible to run an analysis not only on a single model of a collection, but over each model in a collection to be able to aggregate the results. Besides this, we started investigating the adaptation of similarity techniques for clustering of modeling exams. Finally, we want to emphasize that we are aware about the controversial debate about the influence of digital and online elements into the traditional learning processes. We believe that, while the inevitable change from analog to digital is ongoing, it is necessary to address threats and fears like privacy issues or qualitative shortcomings of automated approaches associated with this topic right from the start.

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