Tommy Kubica

Adaptable Collaborative Learning Environments

Erstveröffentlichung in / First published in:
Doctoral Consortium of the European Conference for Technology-Enhanced Learning (ECTEL 2019), Delft, 2019.

Adaptable Collaborative Learning Environments

Tommy Kubica[0000−0001−6406−8571]

Institute of Systems Architecture, TU Dresden, Dresden, Germany
tommy.kubica@tu-dresden.de

Keywords: Audience Response Systems · Backchannel Systems · Adaptation · Collaboration · Roles · Higher Education.

1 Motivation

Audience Response Systems (ARSs) provide a promising opportunity to address issues occurring in traditional higher education, e.g., the lack of interaction, by allowing students to participate anonymously in lectures using their mobile devices. This can promote the students' attention, increase the interaction between the lecturer and the students and foster active thinking during class [16]. In order to choose an appropriate ARS, numerous surveys list and classify these systems according to different criteria, e.g., supported features and platforms [2–4, 8, 12].

However, the introduction of such systems leads to its own challenges: The lecturer has to adjust his/her preferred teaching strategy to the chosen system, as this usually relies on a single supported didactic concept and therefore has a limited, fixed functional scope. Moreover, the lecturer has to select and use the system's functionality and interpret the received data by himself – support or recommendations of a suitable functional scope are rarely provided [7]. Another issue becomes obvious by investigating different didactic concepts: While collaboration with subsequent group discussions is an integral part of various concepts, it is rarely or not at all supported by ARSs [19].

Using the means of adaptation, we target to overcome these limitations. The following research question arises: How can different levels of adaptation support the lecturer in using learning environments in a proper way? To answer this question, three sub-questions will be investigated: How will adaptation in modeling support the lecturer in creating customized scenarios? How will adaptation at runtime support the lecturer by providing collaborative functional proposals? What are trade-offs of using the concept of roles instead of object orientation?

2 Related Work

Current research tends to investigate the benefits of ARSs in different types of lectures, e.g., Hara [4] studied the use of technical tools in tutorials and found value in their usage. In order to support the vast number of scenarios occurring in different types of lectures, the range of functions is usually adapted by simply selecting a range of functions, e.g. in SMILE [20] or Tweedback [22]. In

addition, ARSnova [1] allows for the selection of predefined scenarios that enable a suitable functional scope. To establish a connection between the current scenario and the functional scope, Kubica [7] investigated a guided selection that supports the lecturer in choosing an appropriate range of functions for his/her given scenario. While different settings for individual functions are already provided, the still existing predefined restrictions of functions are to be seen as disadvantages. Klasen (former name Schön) [18] overcomes these limitations by creating a generic model that allows for defining individual and configurable scenarios. During evaluation, the modeling turned out to be very complex and difficult to understand. Although a scenario editor helped to model valid scenarios, it did not simplify the modeling. The reason for this is the generic model which produces deep nesting objects that also lead to long reloading times.

Another issue became obvious by investigating the support of collaborative scenarios, which are an integral part of various concepts [19]. In ARSs, e.g., ClasSense [6], SpeakUp [21] or Tweedback [22], these scenarios are often limited to anonymous question-and-answer functionalities with rating opportunities. Pohl [15] investigated this functionality in more detail and presents an approach that associates questions with a type and a position on a specific slide. Using text markups, it is also possible to send private messages to other students in order to continue an ongoing discussion. Nevertheless, more advanced collaboration, e.g., the creation of groups with subsequent discussions and voting opportunities, is currently rarely supported: PyramidApp [11] allows for iterative rounds of voting on student-created questions, Mobile Learning System [5] enables small groups to solve a task collaboratively by dividing it into several sub-tasks that are executed by a specific user role and ONCOO [13] allows for a *placement*-function that enables collaborative learning but is limited in its number of participants.

3 Adaptable Collaborative Learning Environment

In order to answer the initially defined research questions, the first part is about creating a concept for a learning environment that benefits from different levels of adaptation and supports the lecturer during its proper usage. Our approach is motivated by the advantages of both previously presented groups of existing systems, i.e., systems with a static functional scope and systems that build on top of a generic model. Using ideas derived from model-driven software development, we created a unified (meta-)model [9] that defines different function blocks and parameters for allowing an adaptable modeling of scenarios occurring in technology-enhanced lectures. In addition to function blocks for classical functionalities, collaborative features were also considered. The created (meta-)model builds on top of the concept of workflows [17], which can express conditional, parallel and iterative paths. In order to enable lecturers with different abilities to use the (meta-)model, a graphical editor is developed that allows for an intuitive modeling of function blocks and parameters to create customized scenarios leading to application models. The generated application model will then serve as the input of the runtime environment, which targets its functional scope ac-

cordingly. Using the concept of roles [10], we will maintain flexibility and allow for adaptations at runtime as soon as the application model changes. Figure 1 summarizes the concept of an adaptable collaborative learning environment.

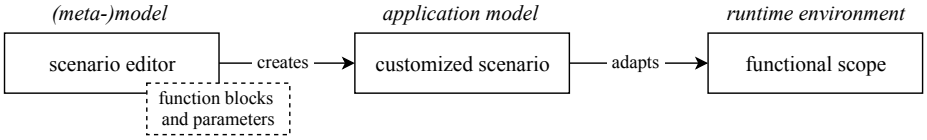

Fig. 1. An adaptable collaborative learning environment that allows for the creation and execution of customized scenarios.

The second part is about investigating the previously defined research questions in more detail. As the foundation of our research, we have chosen the *Design Science Research Methodology* [14], which is suitable for conducting research in information systems by creating and evaluating solutions in the form of artifacts. In the first step, we target to investigate adaptation in modeling in order to support the lecturer in creating customized scenarios. Implementing the previously mentioned graphical editor as an artifact, we will conduct user studies to reason about lecturers' ability to connect their teaching strategy in mind with an appropriate application model. In addition to the graphical editor, the basic functionality of the described concept is implemented to evaluate lecturers' usage of their customized scenarios. In the second step, we will investigate adaptation at runtime, i.e., the adjustment of the functional scope as soon as the application model changes. Our goal is to support the lecturers' correct usage of the system functionality by providing proposals for appropriate collaborative features during the ongoing lecture, e.g., if two or more answers of a single-best choice question are chosen by the students equally often, an online group discussion could be beneficial to clarify misconceptions. Case studies have to be conducted to reason about the lecturers' acceptance towards functional proposals. Last, we will investigate the trade-offs of using the concept of roles instead of object orientation for the previously described steps by comparing the creation, execution and maintenance of role-based and object-oriented artifacts.

4 Conclusion

In this paper, the initial phase of a Ph.D. project was presented, which aims for investigation of different levels of adaptation in order to support the lecturer in using learning environments in a proper way. The adaptation of modeling enables lecturers to create customized scenarios using a graphical editor, which allows for targeted support of own lectures. The adaptation of the runtime enables to adjust these scenarios during the ongoing lecture, e.g., by providing proposals for collaborative functionalities. This will improve the lecturers' correct usage of the system functionality and thus impact the students in a positive manner.

Acknowledgement

This work is funded by the German Research Foundation (DFG) within the Research Training Group Role-based Software Infrastructures for continuous-context-sensitive Systems (GRK 1907).

References

1. ARSnova, `https://arsnova.eu/mobile/#en`, last accessed 15 October 2019
2. Brandhofer, G.: Audience Response Systeme, `https://www.brandhofer.cc/audience-response-systeme/`, last accessed 15 October 2019
3. Flint, J.: Feedback-Proxys zur Digitalisierung von Classroom Response Systemen. Ph.D. thesis, Universität Rostock (2018)
4. Hara, T.C.: Analyses on tech-enhanced and anonymous Peer Discussion as well as anonymous Control Facilities for tech-enhanced Learning. Ph.D. thesis, Technische Universität Dresden (2016)
5. Jagušt, T., Botički, I.: Mobile learning system for enabling collaborative and adaptive pedagogies with modular digital learning contents. Journal of Computers in Education **6**(3), 335–362 (2019)
6. Jiranantanagorn, P., Shen, H., Goodwin, R., Teoh, K.K.K.: ClasSense: A Mobile Digital Backchannel System for Monitoring Class Morale. International Journal of Learning and Teaching **1**(2), 161–167 (2015)
7. Kubica, T., Hara, T., Braun, I., Kapp, F., Schill, A.: Guided selection of IT-based education tools. In: Proceedings of the 47h Frontiers in Education Conference (FIE) (2017)
8. Kubica, T., Hara, T., Braun, I., Kapp, F., Schill, A.: Choosing the appropriate Audience Response System in different Use Cases. In: Proceedings of the 10th International Conference on Education, Training and Informatics (ICETI) (2019)
9. Kubica, T., Shmelkin, I., Schill, A.: Towards a Development Methodology for Adaptable Collaborative Audience Response Systems. In: Proceedings of the 18th International Conference on Information Technology Based Higher Education and Training (ITHET) (2019)
10. Kühn, T., Leuthäuser, M., Götz, S., Seidl, C., Aßmann, U.: A Metamodel Family for Role-Based Modeling and Programming Languages. In: International Conference on Software Language Engineering. pp. 141–160. Springer (2014)
11. Manathunga, K., Hernández-Leo, D.: Pyramidapp: Scalable method enabling collaboration in the classroom. In: European Conference on Technology Enhanced Learning (EC-TEL). pp. 422–427. Springer (2016)
12. Meyer, M., Müller, T., Niemann, A.: Serious Lecture vs. Entertaining Game Show – Why we need a Combination for improving Teaching Performance and how Technology can help. In: Proceedings in the 10th International Conference on Education and New Learning Technologies (EDULEARN). pp. 7030–7039 (2018)
13. ONCOO, `https://www.oncoo.de/`, last accessed 15 October 2019
14. Peffers, K., Tuunanen, T., Rothenberger, M.A., Chatterjee, S.: A design science research methodology for information systems research. Journal of Management Information Systems **24**(3), 45–77 (2007)
15. Pohl, A.: Fostering awareness and collaboration in large-class lectures. Ph.D. thesis, Ludwig-Maximilians-Universität München (2015)

16. Quibeldey-Cirkel, K.: Lehren und Lernen mit Audience Response Systemen. In: Handbuch Mobile Learning, pp. 809–839. Springer (2018)
17. Richly, S.: Autonom rekonfigurierbare Workflows. Ph.D. thesis, Technische Universität Dresden (2011)
18. Schön, D.: Customizable Teaching on Mobile Devices in Higher Education. Ph.D. thesis, Universität Mannheim (2016)
19. Shmelkin, I.: Untersuchung der Adaptierbarkeit webbasierter Audience Response Systeme (2018), https://www.rn.inf.tu-dresden.de/amcs/arbeiten/SCC_HS_WS2018_Shmelkin_-_Untersuchung_der_Adaptierbarkeit_webbasierter_Audience_Response_Systeme.pdf, last accessed 15 October 2019
20. SMILE, https://www.smile.informatik.uni-freiburg.de/, last accessed 15 October 2019
21. SpeakUp, https://web.speakup.info/, last accessed 15 October 2019
22. Tweedback, https://tweedback.de/?l=en, last accessed 15 October 2019