

Making UML “hip”: A First Experience Report on Using Modern Teaching Tools for Object-Oriented Modelling

Marion Brandsteidl, Petra Kaufmann, and Martina Seidl

Institute of Software Technology and Interactive Systems
Vienna University of Technology, Austria
{marion.brandsteidl,petra.kaufmann,martina.seidl}@tuwien.ac.at

Abstract. We steadily aim at improving our first year’s university course *Introduction to Object-Oriented Modelling*. To that end we explore how technological teaching support may be used to extend the classical classroom experience for the students. For several years, we used Web-based out-of-the-box e-learning tools for providing additional teaching support. This solution works well, but has some severe restrictions. In this paper, we show how to overcome these restrictions with a custom implementation. Further, we are now starting to explore mobile facilities as offered by smartphone Apps as well as social media facilities in order to enhance the learning experience in our modelling course. We report on our first experiences with these kinds of technologies.

1 Introduction

For increasing learning efficiency, we continuously add new features to our course *Introduction to Object-Oriented Modelling* (OOM). Besides the presentation of the teaching content in our associated textbook *UML@Classroom* [8], we offer the students the opportunity to use novel technologies in order to learn UML anytime and anywhere following some recent trends in modern communication.

In the current curriculum, OOM is now offered once per year and attended by 400 undergraduate students who study computer science or business informatics at the Vienna University of Technology. In OOM we teach modelling basics by introducing syntax and semantics of the following UML 2¹ diagrams: class and object diagram, sequence diagram, state diagram, activity diagram, and use case diagram. The course consists of lecture videos, demo sessions, a practical part and three exams. In the five *lecture videos* we explain the syntax and semantics of the five considered UML 2 diagrams [1]. In five corresponding *demo sessions* practical examples for each taught diagram type are demonstrated and questions are answered. For the *practical part* the students are divided into groups of about 30-35 persons. Each group meets six times during the semester for so-called “lab sessions” for discussing the solution of exercises.

¹ <http://www.uml.org/>

Three *exams* assess whether the students have reached the learning goals, i.e., if they understand the theory and are able to apply it to small “real world problems” [2]. Additionally, we use different media supporting the different learning methods and needs of our students. The students may choose between learning the UML diagrams with the help of a book [3,7,8], attending the demo sessions, watching the lecture videos or a combination of the three.

Furthermore, we provide support via online forums on the e-learning platform TUWEL², a Moodle³ adaptation of the Vienna University of Technology. We offer various e-learning exercises in the form of multiple-choice questions. The students may voluntarily use the e-learning exercises to test their knowledge about the syntax and the theoretical background of the diagrams, as well as the interpretation of given diagrams. So far the response to the e-learning exercises was very good, so we continuously try to further improve the e-learning exercises according to the feedback we collected from the students over the years. The original version of the exercises was provided via TUWEL, but due to some limitations of this platform we decided to try using other tools instead. We also wanted to find out if it made sense to use more recent, popular technologies which students already seemed to use 24/7 anyway and thus increasing their learning motivation, fun and their learning outcome. Therefore, we implemented three custom variants of our UML Quiz, namely *UML Quiz for Web*, an independent Web-based solution intended as replacement for the exercises in TUWEL on the long-run, *UML Quiz for Smartphone*, a more entertaining and playful version which is currently available as native application for iPhone⁴ devices, and *UML Quiz for Facebook* with a stronger focus on social interaction.

This paper describes our experiences with using the new tools. In Section 2 we explain why the previous solution based on TUWEL was insufficient. In Section 3 we present our new solution based on custom Web technologies and in Section 4 we show how Apps for smartphones or Facebook⁵ may be used for our purposes. In order to learn about the students’ acceptance of these approaches, we performed an online survey which allows us to draw some first conclusions and which provides us some ideas of future work.

2 The Exercises in TUWEL—The Need for Change

The original design of the e-learning multiple-choice questions was done in TUWEL, which was the most obvious choice given that the whole course management was done via TUWEL already and that TUWEL offered a quite powerful module for designing self-assessment tests. A few terms ago we started conducting surveys about our lecture material and we identified two severe drawbacks of TUWEL.

² <http://tuwel.tuwien.ac.at>

³ <http://moodle.org>

⁴ iPhone is a trademark of Apple Inc.

⁵ <http://www.facebook.com>

A generalization relationship between a subclass and a superclass has the following properties:

Select one or more:

- a. The subclass must not have more attributes than the superclass.
- b. A superclass must not be abstract.
A superclass may be abstract.
- c. A subclass can only inherit from one superclass.
- d. The subclass inherits the properties of the superclass.

Check

Incorrect

Fig. 1. Multiple-Choice Question in TUWEL

Answering options. As a part of each exam we also use multiple choice questions similar—but not too similar—to the ones we provide in the e-learning exercises. In the exams the students are given statements about UML diagrams and have to mark if the statements are correct or incorrect. If the students do not know the answer they can decide to leave the question unanswered. This differentiation between wrong and unanswered is not possible in TUWEL. Figure 1 shows a question in TUWEL. It is only possible to mark if a statement is correct. Not marking the checkbox indicates that a statement is incorrect, which is not the desired semantics.

Result display. For the answer options of each question we provide feedback why a certain option is true or false. After a student has solved the questions, he/she can look at the mistakes and the given feedback hopefully helps to gain a deeper understanding. The “solutions”-page has to display a lot of information at the same time namely which answer options were selected, if the option is correct or incorrect and the feedback corresponding to each option. Unfortunately, TUWEL displays this information in a confusing manner. For example, a student marks answer option *b* as correct. After submitting the multiple choice question, the “solutions”-page looks like the screenshot in Figure 1. It is clearly visible that the student only checked option *b* and that his/her overall choice was wrong (indicated by the text stating “Incorrect” at the bottom of the picture). From the text below answer option *b* stating that “A superclass may be abstract”, one can guess that this was not one of the correct answers. Unfortunately, a very important detail is missing: It is not possible to see which answer(s) would have been correct and why. In this example, option *d* would have been correct and the feedback would state that “More concretely, a subclass inherits the structure, relationships, and behaviour of its superclass and may add to it.”, which might help the student understanding the matter. But this feedback is only shown if the answer option is already marked as correct which makes no sense.

Those two disadvantages motivated us to develop a set of tools for various platforms that better suit our needs. During the summer term of 2013, beta versions of those tools were finished and we gave them to our students. This

year, only 10% of the students participated in a survey on the acceptance of the tools, but still we gained valuable feedback which we summarize in this paper. In previous surveys, we had a participation rate of 40% or even higher. The low participation rate took us by surprise. The only reason we can imagine is that this was the first time that we did not use the feedback module of TUWEL but Google Forms⁶ because of its flexibility. It seems that even computer science students are not always easily motivated to try and use “new” tools.

3 UML Quiz for Web

The most obvious choice to overcome the above mentioned limitations of TUWEL was to develop a separate website that offers the desired features. A further requirement was to establish a clearly arranged user interface. For convenience, active learning sessions may be paused and restored later. TUWEL provides an XML export, which we used as input for our new tools. So no data conversion was necessary, guaranteeing a single source of information and therefore equal questions on each learning platform. The beta version of the UML Quiz for Web is available at <http://elearning.uml.ac.at>. The first version was online in mid-April 2013, right a few days before the first exam. At this time already six weeks of the semester had passed and the students were already used to using TUWEL. Nevertheless, we achieved 266 unique visitors with a returning rate of 64.3%. In the survey, the students who tried the website mentioned the following aspects that they liked:

- You have the choice to practice a random subset of the questions.
- You can differentiate between wrong answer options and unanswered ones.
- The design is more appealing than in TUWEL.

Other students mentioned that they needed TUWEL for OOM and other lectures every day anyway and that they saw no additional benefit in using the website. No login is necessary to use the website in contrast to TUWEL where the students must be logged in and every click is recorded. Surprisingly for us, not a single student stated wanting to do the questions anonymously. The one thing they missed about TUWEL when using the website was the “check-it” option. With this option, one can check particular questions right away instead of having to wait for the overall solution of the whole quiz when you actually submit it. This may be considered as some kind of cheating, but as the exercises have no influence on the grade and as it seems to be supportive, we will include this feature as well. Finally, we would like to remark that website is bilingual (German and English) what was not realizable in TUWEL.

4 UML Quiz for Smartphone and Facebook

Whilst a separate website is the most obvious choice, we also wanted to try to use the recent popularity of smartphones and social media for our advantage. The idea was to develop tools for practising the multiple-choice questions

⁶ <http://www.google.com/google-d-s/createforms.html>

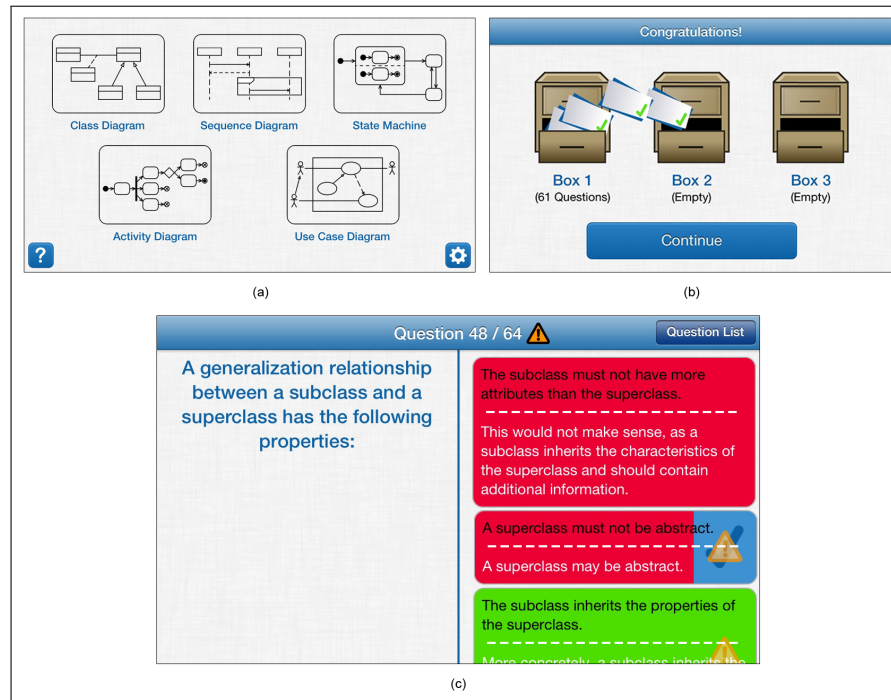


Fig. 2. Screenshots of the UML Quiz for Smartphone

that were also “entertaining” for the students. Due to budget restrictions we announced student projects for a smartphone App. Soon a student who wanted to develop the UML Quiz for iPhone devices came forward, as well as another student proposing to implement the UML Quiz for Facebook, which we also decided to give a try. Figure 2 shows some screenshots of the smartphone App. When starting the App, the user can choose which diagram type he/she wants to practice (Figure 2(a)) and if he/she wants to practice all questions or a random subset. Then the student can navigate through the questions and answer them by marking the correct options. In the App, we still have no distinction between wrong and unanswered answer options. Due to the space limitations on a smartphone display, we decided that this would not be possible without decreasing the usability of the App significantly. The student may save the progress and continue the quiz later at any time. When a quiz is finished, the results and feedback are displayed (Figure 2(c)). The check mark indicates that an answer option was marked as correct, the exclamation mark in the triangle shows which answer options were marked wrongly or were not marked at all. Additionally, correct options are shown in green rectangles while wrong options are depicted in red rectangles. We designed the UML Quiz for Smartphone for game based learning as a flashcard system with three boxes. Each correctly answered question is moved one box further while wrong questions are moved back to box one (Figure 2(b)). So the student can choose to only practice questions he/she has

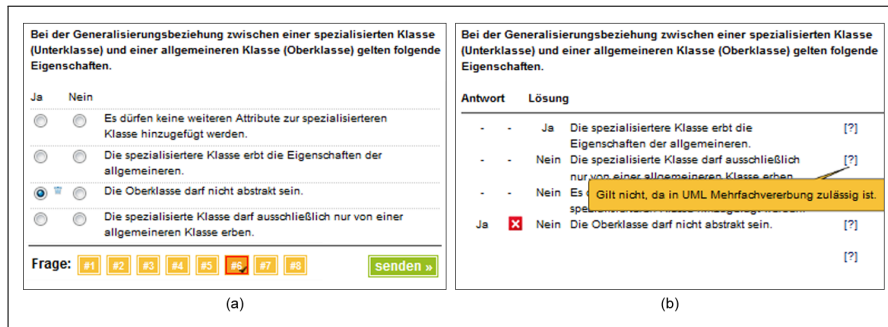


Fig. 3. Screenshots of the UML Quiz for Facebook

not answered correctly yet and thus study more efficiently. The smartphone App was finished by June 2013, only one month before the semester ended. The UML Quiz for Smartphone can be found in the App Store⁷ under the name *UML-quiz*, the App is for free and contains all our questions in an English and a German version (depending on the language set for your smartphone). Within the first month the App was downloaded 392 times, but only 18 times by people with phones registered in Austria indicating that a maximum of 18 students of our course tried the App. Considering that most of the semester was already over and that the overall market share of iPhone devices is about 20%⁸, this number is understandable. The students who used the App mentioned that they liked the flexibility of doing the exercises while they were on the way, when they had nothing else to do while using public transportation. The feedback on why they did not use the App was much more extensive, the following main reasons were given:

- No compatible smartphone available.
- No knowledge about the service.
- Preference of “big” computer screen at home.
- Preference of a more quiet environment where a PC is available anyway.

Unfortunately, the participation rate is not broad enough to draw any conclusions, but it gives a hint that at least the App is not the optimal solution for everyone. Naturally the App was meant as an add-on to the existing tools for exercising while in transit. We will offer the App over the next few semesters and evaluate the feedback carefully to find out if it is reasonable to keep the App as a part of the course material. If the App proves useful, we will also develop native solutions for other smartphone platforms.

A beta version of the UML Quiz for Facebook⁹ went live in February 2012. This App was not updated since then and at this time we had no English questions yet, therefore the App is only available in German. Figure 3 shows two

⁷ App Store is a trademark of Apple Inc.

⁸ <http://bit.ly/19JE4uZ>

⁹ <https://www.facebook.com/umlApp>

screenshots of the UML Quiz for Facebook. The student first chooses a diagram type and can then navigate through the questions and answer them by marking yes (*Ja*) or no (*Nein*) (Figure 3(a)). When a quiz is finished, the results and feedback are displayed (Figure 3(b)). The first column lists the given answers (*Antwort*), the second column indicates if the answer was correct or false and the third column indicates the correct solution (*Lösung*). In the rightmost column, the feedback for each answer option may be faded in by clicking on the [?] icon. While this system of showing which answers were given and which would have been correct uses less graphical icons and colours than the other tools, it seems to be an adequate way to display the results. Some students only seemed to experience difficulties understanding the meaning of the [?] icon. At the end of a quiz, the student could choose if he/she wants to be listed in the highscore list, a feature that a lot of students seemed to enjoy.

The feedback about the UML Quiz for Facebook in general was very diverse, with a few students loving the App posting comments such as *“This is the first useful Facebook App I have ever seen!”* and a few students not trying the App as a matter of principle because they suppose Facebook itself is “evil”. The majority of the students did not try the UML Quiz for Facebook at all, thus sticking to the (in terms of lecture courses) more familiar TUWEL. The positive comments included comments such as *“I wanted to be high up in the highscore list”* and *“It is fun to compare my achievements with my friends’ achievements”*. This indicates that making the exercises competitive might increase at least some students’ motivation to thoroughly do the exercises. For reasons why they did not use the UML Quiz for Facebook the students stated that

- they did not know the App existed,
- they do not like or never/hardly ever use Facebook, and that
- they did not want to be distracted by Facebook messages while studying.

As already mentioned, the UML Quiz for Facebook was not updated since its first version in February 2012. We decided that it may be a good idea to include some sort of competition in our tools but that Facebook was not a suitable platform, mainly for the reason that UML Quiz for Web as described in Section 3 would not “polarize” as much as the UML Quiz for Facebook. Please feel free to use the smartphone App as well as the UML Quiz for Web in your lectures, we are happy to hear from your experiences via the email address `info@uml.ac.at`. Of course our colleagues teaching German speaking lectures could also use the UML Quiz for Facebook but please note that this App will not be updated anymore.

5 Conclusion and Future Work

In this paper, we reported on our experiences with enhancing the course Introduction to Object-Oriented Modelling by tools for nomadic learning [4,5,6] which is studied in the literature for various kinds of subjects. Currently, we are not aware of any published approaches on Object-Oriented Modelling.

All in all, we obtained some valuable experiences. Unfortunately, the new tools were not available at the beginning of the term and therefore a lot of students were already used to TUWEL and did not want to change to another platform in the middle of the semester. We believe that the UML Quiz for Web suits the students' needs much better than TUWEL. The main reason that not all students tried the website was the fact that they could exercise the same questions in TUWEL anyway, they did not realize that they actually got more feedback with each question if they did it on the website. Therefore we think about shutting down the exercises in TUWEL in the future and fully concentrating on the new website. Next term, we will explain more clearly that there are the three tools UML Quiz for Web, UML Quiz for Smartphone, and UML Quiz for Facebook and we will analyze the students' feedback at the end of the semester thoroughly, hoping to improve our tools further.

Using "hip" technologies such as smartphones and social platforms seems to have advantages but also a lot of disadvantages. While using Facebook, there are a lot of distractions and the usage of Facebook seems to be very polarizing among the students. However, some students have fun using the UML Quiz for Facebook even more and competing with other students. For the UML Quiz for Smartphone, more or less the same things apply. In the future, we will learn from the new technologies and integrate some "hip" features in the UML Quiz for Web, which we will also optimize for mobile usage.

References

1. Marion Brandsteidl, Tanja Mayerhofer, Martina Seidl, and Christian Huemer. Replacing Traditional Classroom Lectures with Lecture Videos: An Experience Report. In *Educators' Symposium @ Models 2012*, pages 21–27, 2012.
2. Marion Brandsteidl, Martina Seidl, and Gerti Kappel. Teaching Models @ BIG: On Efficiently Assessing Modeling Concepts. In *Educators' Symposium @ Models 2009*, 2009.
3. Martin Hitz, Gerti Kappel, Elisabeth Kapsammer, and Werner Retschitzegger. *UML@Work, Objektorientierte Modellierung mit UML 2*. dpunkt.verlag, Heidelberg, 2005.
4. Kalle Lyytinen and Youngjin Yoo. Research Commentary: The Next Wave of Nomadic Computing. *Information Systems Research*, 13(4):377–388, 2002.
5. Marcelo Milrad, Michele H Jackson, and Daniel Bergman. Exploring the Potential of Mobile Services to Support Learning and Communication in University Classes. In *Wireless and Mobile Technologies in Education, 2005. WMTE 2005. IEEE International Workshop on*, pages 107–112. IEEE, 2005.
6. Florence Olsen. The Wireless Revolution. *Chronicle of Higher Education*, 47(7), 2000.
7. Chris Rupp, Stefan Queins, and Barbara Zengler. *UML Glasklar. Praxiswissen für die UML-Modellierung*. Hanser Fachbuch, 2007.
8. Martina Seidl, Marion Brandsteidl, Christian Huemer, and Gerti Kappel. *UML @ Classroom: Eine Einführung in die objektorientierte Modellierung*. dpunkt.verlag, Heidelberg, 2012.