Quick and Dirty Group Testing of Mobile app for Educators Teaching Digital Literacy and Production

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DOI: 10.34190/GBL.21.048

Abstract: This paper explores and reflects on the development and testing of a mobile application designed to support lesson planning in digital production and digital literacy. The test results were a reality check for the developer team and provided key points for further development. The paper will describe the test process, divided into plan, results and actions for further development of the mobile application. The application is for use by educators in secondary schools. The application introduces basic methods for teaching digital literacy and production and provides examples of concrete learning designs. It is a huge challenge to teach digital literacy and production in secondary schools. It can be demanding to meet learning goals, plan meaningful activities and at the same time apply emerging digital tools. The application was inspired by game-based learning ideas: for example, we visualized didactical concepts using Augmented Reality (AR). The emerging AR technology combined the physical surroundings and virtual elements. Didactical concepts can be quite abstract for a new educator and the visualizations make them more familiar. The application was developed as part of a funded project exploring AR in teaching and learning in upper secondary schools in the Southern Region of Denmark. The application titled in Danish ROBOdidaktik (robo-didactics) can be downloaded from Appstore and Play store.

Keywords: game-based learning, learning design, design, didactics, digital literacy, computational thinking.

1. Introduction

This paper explores and describes the testing of the app titled in Danish ROBOdidaktik (robo-didactics) for lesson planning in digital production and literacy. The app is meant as a help for educators who are teaching informatics-related topics in secondary school. The first versions of the app were tested by upper secondary teachers and are analysed in this paper. The application was designed utilizing game-based learning ideas e.g. visualizations of some of the more abstract didactical aspects.

It is a huge challenge to teach digital literacy and production in secondary schools. It can be demanding to meet learning goals, plan meaningful activities and at the same time utilize emerging digital tools (Majgaard & Weitze, 2020). Educators are also expected to address ever-new issues of both an ethical and a technical nature. The idea of the app is to holistically guide the educators to think through perspectives of a practical, technical and ethical nature in their planning. Educators who teach programming and emerging technologies often seem to forget the more ethical implications of the technology, while educators focused on the ethical aspects tend to forget the technical and practical aspects (Majgaard, 2018).

The app brings together four fundamentals of course planning in secondary school: (1) traditional learning/teaching design, e.g. planning of academic goals, student activities and organization; (2) methods of digital production, e.g. iterative development and worked examples; (3) digital literacy, e.g. critical thinking and ethics; and (4) contexts, e.g. companies and higher education. The four elements form the didactical model titled Robo-didactics[1]. The model was developed in previous years in a process inspired by action research, between researchers and educators (Majgaard et al 2019; Lamscheck-Nielsen, et al, 2020).
The application was developed as part of a funded project exploring Augmented Reality and didactics in upper secondary schools in the Southern Region of Denmark[2].

Organisation of the paper: first, we introduce the background to the development of the app. This includes a short presentation of the didactical model on which the app is based. Secondly, we introduce the app and how it was developed. Thirdly, we introduce the method of qualitative group testing and the results of the tests. This is followed by reflections on the testing and how it furthers the development of the app.

[1] https://www.robo-sydfyn.dk/
[2] https://arducation.dk/

2. Background

This section presents the didactical model titled Robo-didactic (in Danish ROBOdidaktik). The model can be used for planning all the relevant aspects of course and lesson design in the field of digital production. Furthermore, the model can assist in systematically evaluating and communicating existing courses. The model is the core content of the application.

The model introduces four dimensions, see also figure below:

(1) Teaching and learning design includes common elements of lesson planning such as learning objectives, activities, scaffolding and practical organization (Gynther et all, 2010; Hiim & Hippe, 2007).

(2) Digital production covers development methods such as iterative design cycles, “worked examples”, pair programming pedagogy and the production of video tutorials (Majgaard & Bertel, 2018; Majgaard, 2017; Majgaard, 2015).

(3) The concept of digital literacy embraces the critical and reflective use of technology and digital sources, innovative thinking, and personal and societal positioning in relation to the role of technology (Majgaard, 2018; Brennan et all, 2012).

(4) The environment encompasses collaboration with local companies or other educational institutions, and promotes career learning by gradually involving a wide range of environments in educational processes (Law, 2010).

Read more about the didactical model in the paper titled “Digital Literacy and Course Design” by Majgaard and Lamscheck-Nielsen (2019).

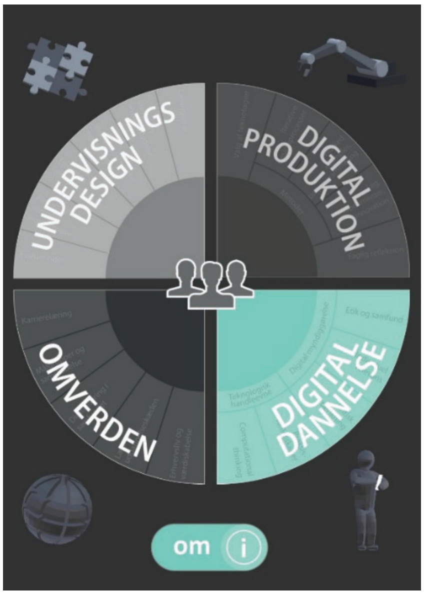

Figure 1: ROBO-didactic model overview of the four dimensions (clockwise from top left: teaching and learning design; digital production; digital literacy; environment;. ‘Om’ = ‘about’)

3. Development and description of the app

Development of the app was a part of the Arducation project[3]. The application was developed using iterative development in round of design, prototype and evaluation (Fullerton, 2008). The first iterations were developed as a part of a Master’s thesis (Langer & Rasmussen, 2020). Each prototype was evaluated by confidants consisting of researchers, members of the Arducation development group or educators. The development process was divided into several iterative steps, described below.

[3] Arducation.dk

Pre-analysis: The master's students had to understand both the Robo-didactics model and the user group.

In order to understand the user groups' computational thinking skills and field of work, the master's students chose to work with the research method of cooperative inquiry and the specific technique of contextual inquiry (Druin, 2002). Contextual inquiry is about observing the user group at work with technologies at hand (Druin, 2002). It is a quick and dirty technique. The master's students conducted a two-hour workshop for four vocational teachers and 20 business studies students on programming simple augmented reality programs using the block-programming environment Co-spaces[4]. The workshop was conducted on an initial computer science course at C-level in upper secondary business studies[5], with educational goals in programming, interaction design and IT security.
All the vocational students, both students and educators, were invited to implement a paper tutorial while one of the master's students led by show and tell, projected from a computer. While one of the master's students conducted the show and tell session, the others observed and interacted with the educators.

The master's students' observations and reflections on the user group: a great divide was observed in the educators' programming skills. The master's students described the teachers as two digital natives and two digital immigrants. According to Prensky (2001), digital natives are people who grew up with technology, often people born in the mid-1980s or later. The digital immigrants are people who have not grown up with the technology, but instead has brought it into their life later. It was clear that the digital natives had a better understanding of using the Co-space user interface and could navigate better. One example was a button to change a scene to AR, that the digital immigrants had a hard time finding. The button was an illustration of a box in 3D. Thus it is important that a user interface is intuitive and easy to navigate for all types of educator, ranging from digital natives to digital immigrants. Previous projects have shown that the master's students' experience fits quite well. Therefore, at advisor level, we supported the master's students' interpretation of the user group.

To give an initial understanding of the Robo-didactic model, the advisor (author) presented the model in detail. Additionally, the group were provided with the paper "Digital Literacy and Course Design" (Majgaard et al, 2019) and access to the Arducation website[4], where the model was introduced and applied.

First iteration: Sketching and first vertical prototype.
The goal of the app was to visualize the Robo-didactic model and provide a simple and interactive tool for course planning. Part of the visualization was to be in AR.

It was decided not to use image-based AR, since it required the users to have target images at hand. The user was to click a button in the app to start AR animations. The prototype was developed in the game engine Unity using the AR foundation package[6] and Google's ARcore[7]. Animations were developed in the open animation tool Blender[8] and afterwards imported into Unity.

The animation design principles were inspired by Frank Thomas and Ollie Johnston (1981), as well as John Lasseter (1987). The principles are based on Disney's animators from the 1930s. The animations in the app had to be simple and understandable. This was done by making the animations, e.g. the movements and gestures, slow and exaggerated, which were two of the animation principles. Assembling a jig-saw puzzle was chosen to visualize the teaching/learning design activity. Jig-saw puzzles are commonly associated with pleasant, time-consuming and complex activities. A four-piece puzzle was an understatement or exaggeration of the concept of a puzzle which, together with the slow, repetitive animation, cut out the conceptual idea of putting the pieces of teaching plan together.
A robotic arm visualized the digital production. A person interacting with a smartphone depicted digital literacy, and a slowly spinning globe envisaged the world outside the educational institution, see figure 1.

[4] https://cospaces.io/edu/
[5] Study plans from the Ministry of Education https://www.uvm.dk/gymnasiale-uddannelser/fag-og-laereplaner/laereplaner-2017/hhx-laereplaner-2017
[6] https://docs.unity3d.com/Packages/com.unity.xr.arfoundation@4.1/manual/index.html
[7] https://developers.google.com/ar
[8] https://www.blender.org/

The first vertical slice presented the user with the AR button which, when clicked, showed an image of the Robo-didactic model and simple animations of the four didactical dimensions.

Second, third and fourth iterations: The app was developed and evaluated and tested in each iteration by teachers, school managers and/or experts within the project team. The fourth iteration was conducted by a new software developer. The third and fourth iterations were uploaded to the app store for both android and iPhone. The app was now rich in content. The content was organized in conceptual descriptions, examples of conducted learning designs and references to further reading.

At this point, we decided to conduct a user test for teachers who were new to both the Robo-didactic model and the app. The previous tests and evaluations had been done with people who knew the didactical model by heart.

3.1 Method for qualitative group testing of the app

The test was planned as quick-and-dirty usability testing combining semi-structured group interviews and think-aloud testing (Fullerton, 2008; Preece et al, 2015). The goal was to test whether the teachers could use the app being designed and whether the app was fit for its intended purpose. The testing was done in a classroom in one of the partner schools, to make the teachers feel at home. With quick-and-dirty methods, we sacrificed rigour and perfectionism to get rapid feedback on the design of the app. Think-aloud testing is a method where the users think aloud during and immediately after testing (Fullerton, 2008). In our case, the users in turn shared their spontaneous unfiltered thoughts immediately after completing a task. In a group, dominant respondents appear occasionally. They can influence other respondents and thereby bias the feedback. In the analysis of the test data, we had to be aware of biases both in the way we asked questions and in the user feedback.

The group testing was conducted with six teachers participating in the same conversation about the application. Five of the teachers were new to the Robo-didactic model and all were new to the app. Four were teachers of digital production. The test was planned to take two hours. Responsibility for the testing lay with a software developer, a researcher, and the project consultant. The software developer oversaw the testing and the others wrote down key points and were available for question regarding the didactical content.

The purpose of the test was to evaluate usability and explore whether the app could be used without conceptual introduction of the Robo-didactic model.

The test plan was divided into three sections: download of the app; small tasks; and ideas for future design. The small tasks were to make sure that the users tried various parts of the app:, see table 1 below. The test manager introduced the test session and the test plan. The purpose of the app as a planning tool for teaching was introduced in general. The Robo-didactic model was not introduced: we wanted to see if the model introduced in the app was self-explanatory.

Test plan – tasks and questions
1) First impression a. Open the app (load time, animations) b. What do you think - can you see what the app represents? (cover design)
2) Functionalities a. What options do you have here on the front page? (button design, alternative model) b. Navigate to “learning objectives” under Teaching design (button design, fan) c. Play video in full screen from “Choice of Technologies” in “the Digital Production” section (back button, fullscreen stop, fan) d. Open "microbits and mathematics" in Computational thinking in the Digital Literacy section (fan, dropdown menu, hyperlinks) e. Open guiding questions in methods, in Computational thinking in the Digital Literacy section (action pattern. Lower Navigation menu)f. Navigate to an AR element in Computational thinking in the Digital Literacy section (action pattern, AR logo)
3) Model understanding a. Find information about roboDidactics (intuitive design) b. Find information on general Arducation courses (intuitive design)
4) Finale a. Imagine that you were to develop a UV course where b. technology is included. Where do you want to lead?

The test manager introduced the questions or tasks and the users solved the tasks. The users were in turn asked to think aloud and reflect on the tasks. A new user started the reflections on each question.

The voices were recorded, and two researchers wrote down points which came to their attention during the test.

4. Results and actions

The results and actions in this section are based on logbook notes and the voice recordings.
The following are examples from each headline of the test plan.

4.1 First impression

Tasks and questions: Download and open app. What do you think – can you see what the app represents?
Description: The teachers downloaded, installed, and opened the Robo-didactics app, titled in Danish "Robodidaktik". The users generally thought the introductory animation was a loading screen. One of the users did not like the Unity signature – and thought it was unnecessary. Half of the group disliked the nudging feature, the other half wanted to press the nudging animation, which resulted in a more detailed version of the Robo-didactic model. Most users found it hard to read the detailed version of the model. The letters were too small.

Actions: The developer team had designed the animation to visualize the content of the app which was not understood by the users. In the light of the user response, we will change the introductory scenes explaining the idea of the app in text and move the intro. scene. Furthermore, we will optimize the font sizes and remove the irritating nudging button.

4.2 Functionalities

In this section we will only introduce examples of feedback from one or two of the tasks.

Tasks and questions: What options do you have on the front page (a)? Open a specific video in full screen mode (c)

Description: The users pressed all parts of the screen and couldn't really see which were buttons and which were illustrations. Given a specific task, the users easily navigated and executed a specific video. It was hard for half of the users to exit full-screen mode.

Actions: This led to us to rethink the design of the buttons and to bug-fix the video presentation mode.

4.3 Model understanding

Tasks and questions: Find information about the Robo-didactics model and find information on general Arducation courses

Description: Most users easily found the 'about' button (in Danish 'om') on the front screen. They were generally critical about all the text found on this page. Some preferred an introductory video. One of the testers thought the didactical model was an invention of researchers and not easy to translate into daily practice. The users also thought it was too difficult to find and access concrete learning designs documented using the Robo-didactic model.

Action: This feedback made us rethink how to make all documented learning designs more visible for users, e.g. by putting them at the top of the pages and menus, where they would be the first thing the users would see. We also decided to write a less theoretical introduction, to emphasize that the model was developed by teachers in a "teacher-to-teacher" action research process guided by researchers (Lamscheck-Nielsen & Majgaard, 2020).

4.4 Finale – design ideas

Tasks and questions: Imagine that you were to develop a course where technology is included. How will you use the app? Do you have any concrete design ideas?

Description: The users had many ideas for design improvements, e.g. changing the dark front page, uniform font types and adding guidance to the AR animations. What they talked about most was easy access to concrete examples of learning designs. They used elements from the Robo-didactic model to describe learning designs which had already been implemented.

Action: We decided to focus on making the examples from practice more visible and easier to access – this was the most groundbreaking feedback. Of course, we would also streamline the design in other areas based on the feedback.

The test was really an eye-opener for us. We were taken aback after the test and planned a meeting one week later for follow-up on the test result. We decided it was best to leave a week for the results to sink in. Below is a table with an overview of design decisions based on the test, see table 2

Test plan – tasks and questions	Design decisions based on the feedback
1) First impression a. Open the app (load time, animations) b. Cover design	- Remove Unity icon. - Remove Initial animation (move it to 'about' menu) - Change detailed Robo-didactic model image and nudging button - Change the four quadrants to become more button-like in a 3D display
2) Functionalities	- Rethink navigation (remove the arrow-fan navigation) - Put links to concrete learning design on top of the pages/menus. - Bug-fix video display - Uniform and larger fonts - Guidance on AR elements
3) Model understanding	- Change 'about' button to 'about Robo-didactic' - In 'about': o Add video at top o Examples of concrete learning designs o Less academic – introduction o Focus on teacher-to-teacher knowledge sharing
4) Finale	- Own template to fill out? (rejected – too time-consuming to program) - More examples from practice – tested learning designs in app documented according to the four basic model perspectives - Examples in the introduction - Uniform and readable fonts

We had one more year to develop the app further. The next step was to decide how to move forward with the project based on the test feedback – did we have time and money, and did we support all design ideas? How ambitious were the project management team?

Meeting one week after the test, we decided on the next steps. The development team and project owner participated in the decision-making meeting.

We decided to compile a prioritized list of the (re)design elements and roughly estimate how many hours to spend per design idea. Top of the list were bug-fixing, simplification of navigation, focus on teacher-to-teacher knowledge sharing, adding more concrete learning designs and making them more visible. Additionally, to guide the users better in the app, we decided that the software developer should draw up a prioritized list based on the discussions in the meeting and the above table, see table 2. Additionally, she should provide design concepts for redesign of navigation, guidance on AR elements and redesign of 'about the Robo-didactics.'

5. Reflection on the test

Based on the test, we realized that the app was not as intuitive as we had expected. The new design decisions needed to improve some of this. Even without an app, it is a big challenge for educators to teach digital production using emerging technologies.

The app was also a communication window on the theoretical didactical model and distribution of successful learning designs using emerging technologies.

In the test, our main aim was to test whether the app was user-friendly and how to improve this aspect. We did not test whether the user understood the theoretical content. It was decided to conduct another test in a coming ROBOdidactic workshop, to see if the app supported learning and dissemination of the didactical model. We are currently planning this test scenario.

6. Summary and conclusion

In this paper we have described the ROBOdidactic model and how we turned the model into a mobile app. The app was developed in several iterations and is still being developed. The app was developed by master's students in engineering and the project was handed over from one team to another as part of the design process. The development of the app was a part of a funded project, Arducation.

The paper illustrates testing as a cornerstone of software development. Planning, conducting, and evaluating the test were key elements. Testing is the single most important activity a developer team engages in, apart from the actual development. A common misunderstanding is that testing is simple and just about gathering feedback from confidants.

The test provided the management and the development team with a reality check, which helped us to move forward in a new direction. Before the test, we thought we were close to our goal with the app. The test showed we still had a long way to go. The test provided us with new knowledge on how to target the app towards the educators. The test provided us with concrete key points such as simplification of navigation, focus on teacher-to-teacher knowledge sharing, highlighting concrete learning designs and toning down the academic jargon.

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