Encapsulating Online Labs in Structured Learning Spaces

Juan Carlos FARAH, Denis GILLET

École Polytechnique Fédérale de Lausanne (EPFL), School of Engineering, Switzerland

Abstract. This paper builds on the results of European research projects to support STEM education with online labs. We present *Integrated Interaction Apps* as a means to support learning activities centered on online labs. We then show how these apps, labs and other resources can be contextualized using *Structured Learning Spaces*, which follow templated layouts based on well-defined pedagogical scenarios. In order to extend the reach of initiatives exploiting these learning spaces, we propose a schema that allows them to be downloaded for offline access via a mobile device. Our schema empowers app designers to define how their apps should behave offline and handle the activity traces they generate.

1 Introduction

In the framework of integrated European research projects and innovation actions [1] referred to as the *Go-Lab Initiative*, a general architecture and an ecosystem [2] have been defined and implemented to exploit online laboratories (labs) for STEM education. The exploitation of online labs in learning activities has been proven to be more effective from a pedagogical point of view when additional multimedia resources and support applications (apps) are provided. In this paper, we present how *integrated interaction apps* interfacing online labs and providing learning support are designed and how *structured learning spaces* [3] can be created, personalized, and implemented using predefined templates. These templates provide pedagogical scaffolding to support various learning scenarios and activities. Following the *mobile-first* paradigm and the fact that often school IT infrastructure is not ready for full-fledge online activities, we also discuss how the proposed apps and spaces can be designed for offline access via mobile devices.

2 Integrated Interaction Apps

Integrated interaction apps range from interfaces for remote labs, to simulations powering virtual labs, to scaffolding applications that support the learning activities within which these labs are embedded. Interaction apps are labeled “integrated” as they are designed to coalesce both knowledge development components (learning-outcome-oriented) and self-reflection features (learning-analytics-oriented).

Apps have a **front-end** offering a graphical user interface and a **back-end** supporting various features and services, such as user authentication, networking with remote labs, processing user input, collection and storage of experimentation data and user activity traces, computation and visualization of learning analytics (LA), as well as communication with the platform hosting the app (if any). Storage can be built into the apps themselves or can rely on external repositories using proprietary or standard formats (such as xAPI). Communication with the enclosing platforms can also rely on ad hoc or standard solutions (such as LTI).

Given app designers themselves are best poised to offer meaningful analytics related to how their app is exploited, each app handles the production and consumption of activity traces, as well as its use of these traces to compute and display LA. In addition, apps are able to adapt these analytics to different contexts and users, i.e. different LA can be displayed depending if the apps are being accessed by teachers or by the students themselves.

3 Structured Learning Spaces

While standalone usage of integrated interaction apps is always possible, it is better to offer additional resources—such as introductory material—and encapsulate them within a pedagogical structure suited for the specific learning activity at hand. The learning spaces introduced by the Go-Lab initiative provide such a structure to support inquiry-based learning (IBL). When the space is browsed by students, the IBL structure is enforced using tabs corresponding to the typical inquiry phases, but can be generalized for other pedagogical scenarios, such as lectures (slides), MOOCs (modules), or eBooks (chapters).

Furthermore, structured learning spaces can be made available for offline access by downloading the data required to render it on a mobile device with no internet access. Although certain apps might not be available (e.g. remote labs), all resources will be converted for offline use during download. As with LA, each app can handle this process differently, with app designers able to specify custom download procedures within their apps.

4 Conclusion

This paper introduces to concept of apps supporting learning activities with online labs and integrating both investigation and LA features. It then presents a general model for designing offline-ready learning spaces that enrich online labs with interactive resources, and structuring them so students can exploit these spaces according to well-defined pedagogical templates.

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References

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