

Chapter 14

Design and Implementation of an IDE for Learning Programming Languages Using a Gamification Service

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ABSTRACT

This chapter presents the architecture and design of Enki, an Integrated Development Environment (IDE) for learning programming languages on Massive Open Online Courses (MOOCs). This environment can be used as a tool by a Learning Management System (LMS) and a typical LMS such as Moodle can launch it using the Learning Tool Interoperability (LTI) API. Student authentication tokens are passed via LTI, thus integrating Enki in the single sign-on domain of the academic institution. The proposed tool has a web user interface similar to those of reference IDEs, where the learner has access to different integrated tools, from viewing tutorial videos, to solving programming exercises that are automatically evaluated. Enki uses several gamification strategies to engage learners, including generic gamifications services provided by Odin and the sequencing of educational resources. The course content (videos, PDFs, programming exercises) is progressively disclosed to the learner as he successfully completes exercises. This is similar to what happens in a game, where new levels are unlocked as the previous are completed, thus contributing to the sense of achievement.

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INTRODUCTION

Environments for learning programming languages have very precise requirements. Students need editors and compilers of the languages they are learning, in specific versions. If students attend practical classes in a lab then it is fairly easy to ensure they all have access to all the tools they need. However, if the students are enrolled in a MOOC, they must install themselves these tools on their own computers or devices. Installing software such as compilers is too complex for many students of introductory programming courses, and some may even use devices where these installation is not feasible, such as in tablets.

Enki is a programming learning environment designed for students enrolled in MOOCs. It integrates several features surveyed in Section 2, which are commonly found in e-Learning environments. It provides a user interface deployed on the web with automated assessment running on a remote server and was designed to interact with several e-Learning systems. The most common of these systems is the Learning Management Systems (LMS) that is interlinked with Enki using the LTI specification. Enki communicates also with more specialized e-learning systems, namely with a content sequencing engine named Seqins. However, the most distinctive interoperability feature of Enki is the use of a gamification service.

The use of game concepts and mechanics in eLearning is an effective way to engage learners. Techniques and tools that have proven their effectiveness in computer games are routinely exploited in other areas of software development. The use of this approach led to the concept of gamification as a service, provided by major players such as Google and Microsoft. These services leverage on their large user base to provide support for points, leaderboards and badges, requiring a specific authentication from the client application.

However, e-learning systems are typically deployed in environments with a single sign-on managed by an academic institution that should not require students to have an account with a third party. Odin is a gamification service designed to circumvent this obstacle. It retains the salient features of the gamification services of reference without requiring registration of the end users. Its API is inspired in the Google Play Game Service (GPGS) with minor adjustments regarding user identification.

Section 3 presents Enki. It starts with a description of the IDE inspired user interface. Then, it describes the architecture of which Enki is the visible face. It encompasses Mooshak, the automated evaluation system hosting Enki, as well as gamification services, sequencing services and learning management systems. It also details an use case that shows how these components are interconnected. Section 4 concludes the chapter with an highlight of the main features of the described system.

BACKGROUND

Teaching computer programming is considered to be difficult and often ineffective (Robins, Rountree, & Rountree, 2003). Our tool, Enki, is a web-based IDE designed to be integrated on MOOCs that allows users to learn computer languages efficiently. To the best of the authors' knowledge, there is no tool in the literature that provides all the Enki features such as gamification features, sequencing of educational resources, social collaboration, automatic evaluation and standard LMS integration. So, this section surveys systems with some of these features.

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