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# LTI Integration (software)

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## Technical Report

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## 1. Executive Summary

This document provides a guide with all the steps for the IMS LTI [7] integration between a Learning Management System (LMS) - in this case, Moodle LMS [5] -, and the Framework for Gamified Programming Education (FGPE) [6] ecosystem, namely, the Programming Learning Environment (PLE) [3].

It is a direct result of the work done during the first phase of the project “FGPE Plus: Learning tools interoperability for gamified programming education” [4].

Section 2 details this document’s background, purpose, and scope.

Section 3 enumerates and explains all the required steps needed to connect the FGPE ecosystem with an LMS platform.



## 2. Introduction

### 2.1. Background

One of the outputs of a previous Erasmus+ project (FGPE [6]) was an open-source gamified interactive environment for learning programming (PLE [3]). It is implemented as a separate web platform to which a student can log in to solve programming exercises served in a gamified form (e.g., as challenges and quests rewarded with points and badges, etc.).

This means that the student has to leave the LMS platform to solve the exercise(s), and his/her achievements are not transferred back to the LMS platform. Therefore, the instructor also has to log into the FGPE platform instructor's panel to see the individual students' progress and, finally, has to combine this data with the LMS-based student activity data to produce the final grade.

The primary objective of the Framework for Gamified Programming Education Plus (FGPE+) project is therefore to fill the gap between interactive learning environments and popular LMS platforms using an LTI-based approach, in specific, to open the FGPE ecosystem to educational environments.

In this context, the FGPE PLE is called to handle the programming exercises' presentation and assessment, and only the resulting data is transferred back to the LMS. This is much more flexible and sustainable compared to writing plugins for popular LMS platforms, i.e., by providing an LTI-compliant interface to FGPE, any LTI-compliant LMS can be connected to it. Using the plugin option, every LMS would require a dedicated plugin written only for it and any updates to LMS code could render older plugins incompatible. Furthermore, the LTI, as an established standard, is expected to stay for a considerable time.

### 2.2. Purpose

The purpose of this document is to present a guide with all the steps to allow the integration of the PLE tool with an LMS (Moodle) using the IMS LTI specification.

The expected impact of this first phase of the project is significant, as it removes the main identified limitation in the adoption of the FGPE framework, i.e. the ability to combine programming exercises within courses provided via other e-learning platforms. Apart from satisfying the needs described above, it also addresses the psychological barrier of instructors being reluctant to add yet another platform to the portfolio of their educational IT tools, whereas the LTI-compliance allows treating gamified programming exercises as yet another type of exercise to be placed within the courses provided via an LMS, that they already know and use.



It is expected that this document can be useful in other domains by replicating all the steps contained herein in order to link other environments into an educational setup.

## 2.3 Scope and related documents

This document covers the first phase of the project “FGPE Plus: Learning tools interoperability for gamified programming education” [4].

This document provides a guide for the replication of the LTI integration between the LMS and the FGPE Ecosystem.

This document is to be used by the team members of the FGPE plus project [4].

A video demonstration was prepared exemplifying all the integration steps between the PLE and Moodle LMS [8].

## 2.4 Acknowledgments

This document is a direct result of the work done within the FGPE Plus: Learning tools interoperability for gamified programming education project supported by the European Union’s Erasmus Plus programme.

Although the editors of this document are listed on page 2, its content reflects the results of the intellectual work of all the involved project team members:

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- on behalf of CRACS University of Porto: Ricardo Queirós, José Paulo Leal and Pedro Ferreirinha,
- on behalf of Kaunas University of Technology: Rytis Maskeliunas,
- on behalf of University of Napoli Parthenope: Raffaele Montella.



## 3. Setup

The FGPE ecosystem needs to be connected to each LMS platform separately. To this end, some configuration steps are required in several tools of this ecosystem. The next subsections describe each configuration step in detail.

### 3.1. Enabling Keycloak Features

Authentication and authorization in the FGPE ecosystem is managed through Keycloak [1], an open-source identity and access management solution providing features such as centralized user management, and several authentication mechanisms, single sign-on and identity brokering, and social login. As we now intend to automatically authenticate users through LTI, the new authentication flow must

1. Create a user in Keycloak (if it does not exist)
2. Exchange the admin token by an access and a refresh token
3. Send these to the PLE [3] launched instance

For step 2, we require a *preview* feature of Keycloak, namely Token Exchange permission. To give this permission to a client, however, fine-grained permissions are also required, which is another *preview* feature. To enable both of them, try to boot the Keycloak server using these system properties:

```
-Dkeycloak.profile.feature.admin_fine_grained_authz=enabled  
-Dkeycloak.profile.feature.token_exchange=enabled
```

Or, if using Docker, create a file `configs/profile.properties` with the following contents:

```
profile=preview  
feature.account_api=enabled  
feature.admin_fine_grained_authz=enabled  
feature.token_exchange=enabled
```

and attach it as a volume to the Keycloak container by adding to `docker-compose.yml` the following volume entry

```
./configs/profile.properties:/opt/jboss/keycloak/standalone/configuration/profile.properties
```



## 3.2. Adding External Tool into Moodle

FGPE ecosystem, particularly the FGPE Gamification Service [2], is the LTI tool provider (TP) of this LTI integration. Therefore, we must add it as such in the LTI tool consumer (TC), i.e., the LMS (Moodle) [5].

To this end, sign in to Moodle as an administrator and go to

**Site Administration > Plugins > External tool > Manage tools**

There, click the link just below the text input, namely **configure a tool manually**. This opens the External tool configuration form. Fill in the **Tool settings** section, as presented and described below.

▼ **Tool settings**

Tool name	<input type="text" value="FGPE PLE"/>
Tool URL	<input type="text" value="https://fgpe.dcc.fc.up.pt/gamification-service/lti"/>
Tool description	<input type="text" value="FGPE PLE - LTI Tool. Launch activities in the PLE from Moodle with this integration."/>
LTI version	<input type="text" value="LTI 1.3"/>
Public key type	<input type="text" value="RSA key"/>
Public key	<input type="text"/>
Initiate login URL	<input type="text" value="https://fgpe.dcc.fc.up.pt/gamification-service/lti/login"/>
Redirection URI(s)	<input type="text" value="https://fgpe.dcc.fc.up.pt/gamification-service/lti"/>
Custom parameters	<input type="text"/>
Tool configuration usage	<input type="text" value="Show as preconfigured tool when adding an external tool"/>
Default launch container	<input type="text" value="New window"/>
	<input type="checkbox"/> Supports Deep Linking (Content-Item Message)
Content Selection URL	<input type="text"/>

[Show more...](#)





1. The **Tool name** can be any name of your choice. We recommend naming it one of **FGPE**, **FGPE PLE**, or **PLE**.
2. The **Tool URL** should be the URL to the FGPE Gamification Service [2] suffixed with **/lti**, i.e., **<GS\_URL>/lti**
3. Add a small sentence about the tool in the **Tool description**, just for informational purposes.
4. Choose **LTI 1.3** in the **LTI version**.
5. Choose **RSA Key** in the **Public key type**.
6. Let the **Public key** blank. This will be filled out later when we register the LMS (Moodle) as the TC in the FGPE Gamification Service.
7. The **Initiate Login URL** should be the URL to the FGPE Gamification Service suffixed with **/lti/login**, i.e., **<GS\_URL>/lti/login**
8. In **Redirect URL(s)** add the same value as in **Tool URL**, i.e., the URL to the FGPE Gamification Service suffixed with **/lti**. In this case, the HTTP method used will be GET, not POST as in the **Tool URL**.
9. Finally, set the **Default launch container** to **New window**.

In the Services section,

1. Select **Use this service for grade sync and column management** in **IMS LTI Assignment and Grade Services**. This will allow the FGPE Gamification Service to grade the student.
2. Set **Use this service to retrieve members' information as per privacy settings** in **IMS LTI Names and Role Provisioning**. This will allow the FGPE Gamification Service to get the user role.
3. Set **Do not use this service** in **Tool Settings**.

Finally, in the Privacy section, select the option **Always** for fields **Share launcher's name with tool**, **Share launcher's email with tool**, and **Accept grades from the tool**. You may confirm in the image below



Services

IMS LTI Assignment and Grade Services

IMS LTI Names and Role Provisioning

Tool Settings

---

Privacy

Share launcher's name with tool

Share launcher's email with tool

Accept grades from the tool

Force SSL

---

Miscellaneous

Default organisation ID

Organisation ID

Organisation URL

Finally, click **Save changes**. The **Client ID** will be filled in automatically, and is necessary for the next step.

### 3.3. Registering in the FGPE Ecosystem

The LMS platform needs to be registered in the FGPE ecosystem to get the Public Key, which allows signatures of incoming messages and service requests to be verified.

```
curl --request POST \
  --url <GS_GRAPHQL_URI> \
  --header 'Content-Type: application/json' \
  --cookie KEYCLOAK_JWT=<TEACHER_ACCESS_TOKEN> \
  --data '{"query": "mutation($name: String!, $clientId: String!, $url: String!) {\n\tregisterPlatform(name: $name, clientId:
```



```

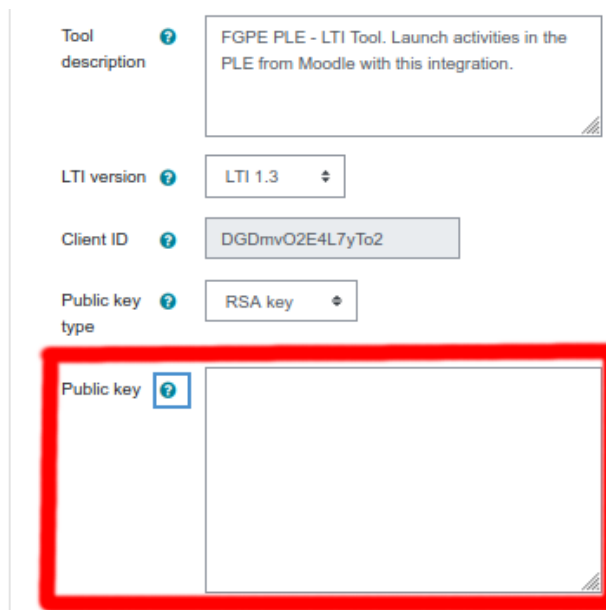
$clientId, url: $url)
{\n\t\tpublicKey\n\t}\n}", "variables": {"name": "<TOOL_NAME>", "clientId": "<TOOL_CLIENT_ID>", "url": "<MOODLE_URL>"}}'
    
```

This request originates a JSON object response, containing the Public Key, as follows

```

{
  "data": {
    "registerPlatform": {
      "publicKey": "<PUBLIC_KEY>"
    }
  }
}
    
```

This registration can also be made through a form in the Teachers' UI of the FGPE PLE. The obtained Public Key should be added to the external tool in Moodle, as presented below



Tool description: FGPE PLE - LTI Tool. Launch activities in the PLE from Moodle with this integration.

LTI version: LTI 1.3

Client ID: DGDmvO2E4L7yTo2

Public key type: RSA key

Public key: [Empty text area highlighted with a red border]

### 3.4. Adding Activities

After fully configuring the External Tool, teachers may add activities into a course by clicking **Add an activity or resource** and choosing **External Tool**.

There,

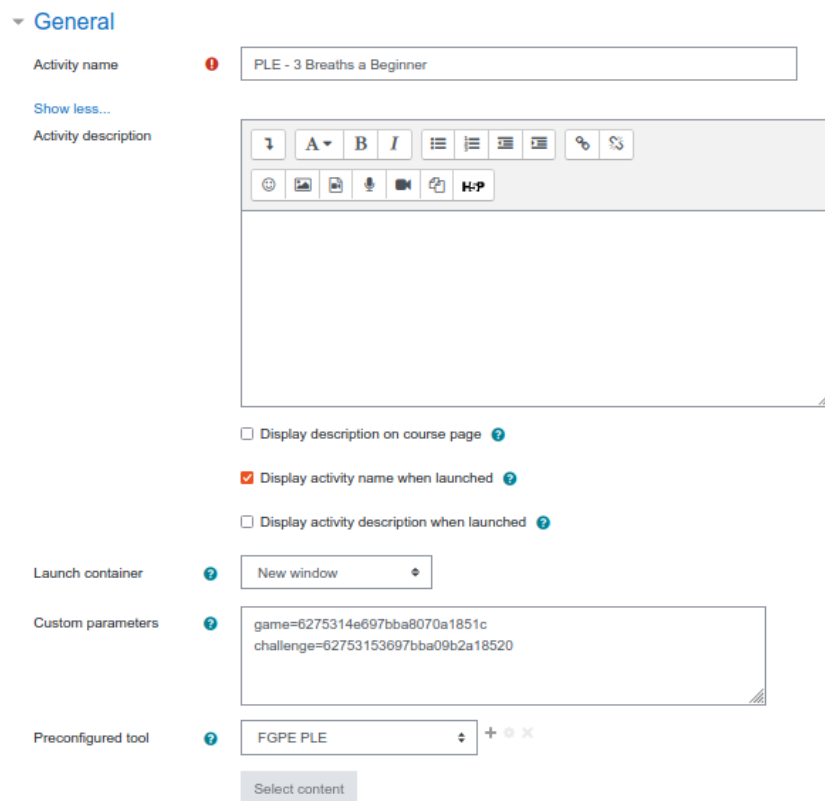
1. Select the added tool (in this case, **FGPE PLE**) in **Preconfigured tool**.
2. Add a name and a description to the activity.
3. Select **New window** as **Launch container**.
4. In **Custom parameters**, you should insert the **game** and **challenge** to be solved. Optionally, you may specify an **activity**. The format is as follows

```

game=<GAME_ID>
challenge=<ACTIVITY_ID>
activity=<CHALLENGE_ID>

```

You may refer to the picture below.



**General**  
 Activity name: PLE - 3 Breaths a Beginner  
 Activity description: [Rich text editor]  
 Display description on course page  
 Display activity name when launched  
 Display activity description when launched  
 Launch container: New window  
 Custom parameters: game=6275314e697bba8070a1851c  
 challenge=62753153697bba09b2a18520  
 Preconfigured tool: FGPE PLE  
 Select content

In the Privacy section, enable all options, namely **Share launcher's name with the tool**, **Share launcher's email with the tool**, and **Accept grades from the tool**.



In the Activity Completion section, set **Completion tracking** to **Show activity as complete when conditions are met** and enable the **Require grade** option. Please refer to the image below.

▼ Privacy

- Share launcher's name with the tool ?
- Share launcher's email with the tool ?
- Accept grades from the tool ?

---

▼ Grade

Grade ?

Type

Maximum grade

Grade category ?

Grade to pass ?

---

▶ Common module settings

---

▶ Restrict access

---

▼ Activity completion

Completion tracking ?

Require view  Student must view this activity to complete it

Require grade  Student must receive a grade to complete this activity ?

Expect completed on ?       Enable



## References

- [1] Keycloak (2022). Keycloak - Open Source Identity and Access Management. <https://www.keycloak.org/>. Last updated at 2022-06-25.
- [2] Paiva, J.C., Haraszczuk, A., Queirós, R., Leal, J.P., Swacha, J., Kosta, S. (2021). FGPE Gamification Service: A GraphQL Service to Gamify Online Education. In: Rocha, Á., Adeli, H., Dzemyda, G., Moreira, F., Ramalho Correia, A.M. (eds) Trends and Applications in Information Systems and Technologies. WorldCIST 2021. Advances in Intelligent Systems and Computing, vol 1368. Springer, Cham. [https://doi.org/10.1007/978-3-030-72654-6\\_46](https://doi.org/10.1007/978-3-030-72654-6_46)
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- [4] FGPE Plus Consortium (2022). FGPE Plus website. <https://fgpeplus.usz.edu.pl/>. Last updated at 2022-06-27.
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- [8] FGPE PLE and Moodle LMS integration process video demonstration (2022). <https://fgpe.dcc.fc.up.pt/public/demo-lti.mp4>. Last updated at 2022-06-27.

