

Development and Implementation test of LTI Gateway System to Improve Interoperability of Educational Systems

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This study focuses on simplifying the integration of external learning tools into the Next Generation Digital Learning Environment (NGDLE) using Learning Tools Interoperability (LTI). Developing LTI tools is challenging due to high costs and varying technical requirements. To address this, we propose an LTI gateway system that separates LTI functionality from the external learning tools, facilitating interoperability. The system was implemented using Ltijs in JavaScript and supports two communication methods: the redirect method and the relay method via GET/POST. Implementation tests showed that both methods successfully registered grades; however, the relay method proved more effective for interoperability, as it required only a single path configuration. Future work will focus on verifying the compatibility of this system with external learning tools developed using stateful web frameworks.

Key words: Learning Tools Interoperability, Learning Management System, e-learning, Next Generation Digital Learning Environment

1. INTRODUCTION

With the increasing digitization of education, Higher education institutions are adopting learning tools such as e-learning systems. In this context, the realization of Next Generation Digital Learning Environment (NGDLE) [1] is required. Learning Tools Interoperability (LTI) [2] is a standard that enables interoperability between some Learning Management Systems (LMSs) and external learning tools to realize this environment. LTI enables individual learning support tools (LTI tools) to provide functions as plug-ins to a LMS as LTI platform that serves as the central learning portal within an educational institution.

On the other hand, development of LTI tool has several barriers: including high development costs, abundance of development examples for each programming language and/or frameworks and varying levels of support for the LTI specification. Therefore, it is necessary to pursue methods to make it easier to convert existing external learning tool into LTI tools for NGDLE integration.

This study aims to establish a technical method that enables separate systems to provide the core functions of LTI and the external learning tool of providing educational services itself. Specifically, it examines a mechanism where LTI gateway system manages processes to support the LTI specification side, while the external learning tool handles processes on the educational service provider side. This separation aims at these systems to operate as an integrated LTI tool, facilitating interoperability and easing development hurdles.

2. DEVELOPMENT OF LTI GATEWAY SYSTEM

2.1 System overview

The system overview is illustrated in the following Figure1.

In this system, the LTI gateway system manages processes that support the LTI specification side. If external learning tools can be integrated with this system, it is expected that these tools can be utilized in the same way as LTI tools.

In this study, we conduct a technical evaluation of the process in which the LTI gateway system integrates with an external learning tool and registers grade information from this tool to the platform using the core functionalities of LTI. Specifically, we developed the LTI gateway system and implemented two communication methods between the LTI gateway system and external learning tools: the redirect method and the relay method using GET/POST. The upper part of Figure 2 shows the code used in the redirect method, while the lower part presents the code used in the relay method.

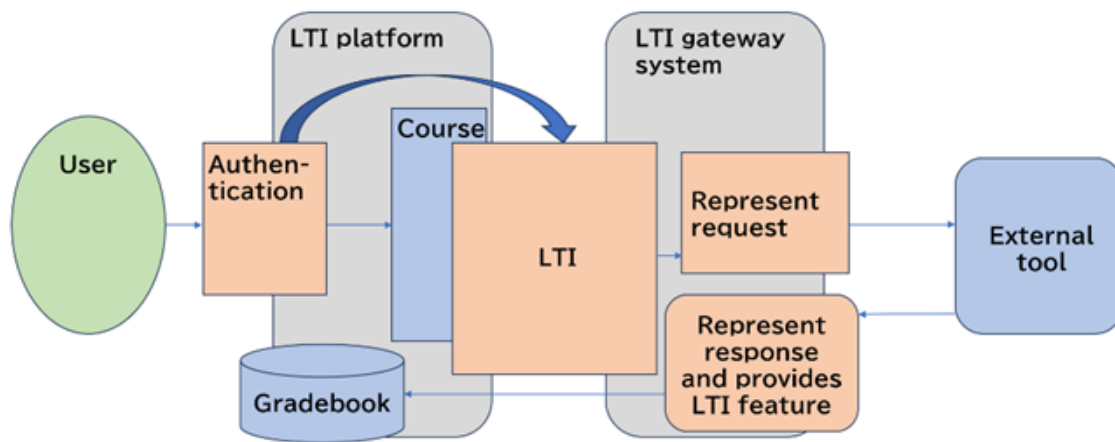


Figure1. System Overview

```
lti.onConnect( abort: async (token, req, res) => {
  console.log(token)
  const redirectUrl = 'https://
  return res.redirect(redirectUrl)
})
request.get({
  url: redirectUrl,
}, function (error, response, body){
  return res.send(body)
});
```

Figure2. Comparison of Two Methods

2.2 Behavior of our LTI gateway system

The LTI gateway system is based on Ltijis and implemented in JavaScript, enabling multiple platforms to connect to a single external learning tool. This system can be registered as an external learning tool on the LTI platform and utilized accordingly. The LTI gateway system handles requests and responses to the external learning tool, enabling it to provide services from the external learning tool to the LTI platform as if they were delivered by an LTI tool.

3. IMPLEMENTATION TEST

We conducted implementation testing of the grade registration functionality using two methods: the redirect method (first method) and the relay method utilizing GET/POST (second method). We introduce each method in the sections below. Figure 3 shows the user interface of the custom survey tool used in the implementation tests. This tool was developed as an external tool using a stateless framework to validate the functionality of the LTI gateway system.

The first method involves redirecting requests from the LTI platform directly to the external learning tool. Figure 4 illustrates the communication flow of the first method. The second method involves creating a new request to the external learning tool based on the request message received from the LTI platform. Similarly, it generates a response to the LTI platform based on the response message received from the external learning tool. Figure 5 illustrates the communication flow of the second method.

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☐ 強くそう思う
 ☐ ややそう思う
 ☒ どちらとも言えない
 ☐ あまりそう思わない
 ☐ 全くそう思わない

本日の講義に関する意見をできるだけ具体的に書いてください。
(興味・関心を持った点、将来に役立つと感じた点、講義の感想等について記入してください。)

送信

Figure 3. User Interface of the Custom Survey Tool

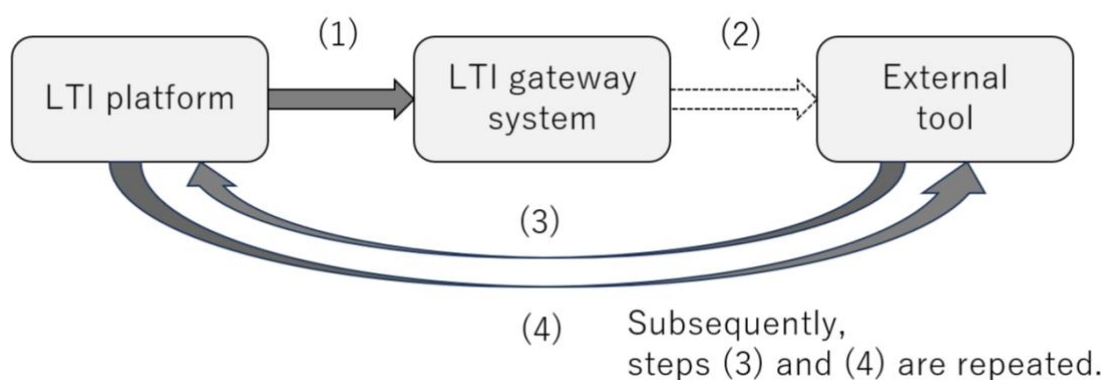


Figure 4. Communication Flow of the First Method

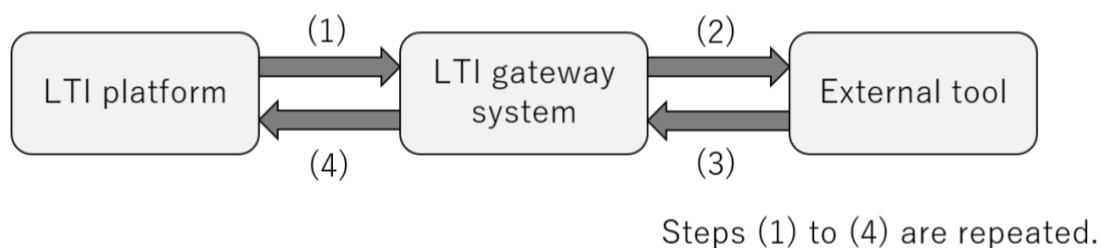


Figure 5. Communication Flow of the Second Method

4. RESULTS

The differences between the two methods identified through testing are discussed below. In the first method, the absolute path of the LTI gateway system must be specified as the communication destination for the external learning tool. In contrast, the second method requires the relative path of the LTI gateway system to be set as the communication destination for the external learning tool. When connecting multiple platforms to a single external learning tool, each platform requires an individual absolute path configuration, whereas a relative path configuration only requires setting a single path. Table I summarizes the key differences between the two methods based on the testing results. While the second method offers better scalability, it was observed that page loading speed decreased compared to the first method. Although a decrease in page loading speed was observed, it was not significant enough to cause major issues.

Based on the results, the second method is more effective for enhancing interoperability in the envisioned behavior of the LTI gateway system.

Table I. Comparison of the Two Methods

| | Operation Status | Scalability | Loading Speed |
|---------------|------------------|-------------|---------------|
| First method | ✓ | ✗ | ✓ |
| Second method | ✓ | ✓ | ✗ |

5. CONCLUSION

Based on the tests, both methods successfully completed the grade registration process. However, the second method is more suitable for supporting a broader range of LTI functionalities. In future work, ensuring the compatibility of this system with external learning tools are developed using a stateful web framework. Therefore, it is necessary to verify the compatibility of various frameworks.

6. REFERENCES

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