Modern Containerised Learning Interface and Deliver Infrastructure (MCLIDI)

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Executive Summary

The Modern Containerised Learning Interface and Delivery Infrastructure project developed and deployed a modern online learning environment and the required delivery infrastructure. The technical solution developed within the project made heavy use of existing open-source technologies and protocols. The core element of the solution is the Virtual Computing Environment (VCE), which is based on a Docker container and contains all the software and data that the student requires to undertake their studies. The VCE can then either be run locally by the student on their own hardware or via an online hosting setup that was based around multiple Jupyter Hub installations. By basing the project on existing technologies, the project managed to go from initiation to testing in two months and into a live deployment within a further eight months. Over the duration of the project more than 1500 students were successfully supported, with only 28 students experiencing issues with the infrastructure. This clearly demonstrates the success of the project. The solution developed within the project has now been rolled out as the “Open Computing Lab”, providing access to this kind of provision to any module in the STEM faculty.

Aims and Scope

The aim of the Modern Containerised Learning Interface and Deliver Infrastructure (MCLIDI) project was to develop and evaluate a modern container-based learning interface and delivery infrastructure, with a particular focus on students with disabilities and neurodiversities. It was expected that the new learning interface and delivery infrastructure would offer a better study experience and help improve retention and progression in TT284. The project's objectives were as follows:

- to understand technologies and requirements for students with disabilities and neurodiversities
- to develop the new learning interface and delivery infrastructure
- to gather feedback from students and ALs, as well as automatic monitoring of their interactions with the system
- to analyse the students' and ALs' feedback together with the collected analytics data
- to disseminate the project's outcomes such as our experiences and technologies both inside and outside The Open University

Activities

The MCLIDI project primarily took a technology development and deployment approach. We developed and deployed a technical solution, combining off-the-shelf open-source software with a custom interface, allowing students to access virtual computing environments (VCE) online. These VCEs provide the student with all the tools they need to undertake their practical exercises in a single environment, which can be extensively pre-tested and ensures that all students have the same experience.

The core element of the solution is the "container", which is a pre-defined set of software components that are distributed as one unit. This container is developed and tested by the Module Team (MT). The container is then loaded into the delivery system, from where it can be accessed by students using their browser. Because the content of the container and the environment it is run in is exactly the same for every student, the MT can test the container via the delivery system before the module starts. If it

works for the MT at that point, it will behave exactly the same for the students.

The original project plan used a three-phase approach to develop the tooling described above, with the first phase (9 months) focused on developing and testing the software, the second phase (11 months) covering the pilot phase, and the final phase (2 months) allocated for analysis and dissemination.

In practice the use of off-the-shelf and existing components for the majority of the tools allowed us to complete the first phase after 2 months and run a pilot with TM129 21B students (funded via the TM129 module budget) during the period of April-September, which validated that all the components together worked correctly.

Due to this faster progress, the second phase saw the project rolled out as an open pilot to TT284 21J students and as a live solution to TM129 21J, TM129 22B, and S397 21J students (funded via their respective module budgets). Additionally, the launch interface software components were also re-used by a similar provision provided by STEM Technical Services for TM351 21J and M269 21J. Overall over the duration of phase 2, the MCLIDI project supported over 1,500 students, running over 12,000 sessions.

As planned, at the end of the 21J presentation we invited Associate Lecturers (ALs) from TT284 to participate in a focus group and also distributed a survey to students on TT284, TM129, and S397 (over 2,500). Unfortunately the response rate on both these was disappointingly low, with 2 ALs participating in the focus group and a total of 7 students responding to the survey. The 7 participants were also invited to a focus group, but none took up the invitation. Of the 7 students 3 misunderstood the focus of the survey and answered it in respect to a different online provision that TM129 provides, meaning their responses had to be discarded.

The result is that phase 3, which was designed to undertake analysis of the student performance and feedback, was not undertaken. 4 Students and 2 ALs is insufficient data to draw any kind of scholarly conclusion. Since, except for the 4 study participants, we did not have any link between

students using the system and other data from the module, we were also not able to investigate whether the project had any impact on their performance, retention, satisfaction, or any other feedback. However, we did acquire some qualitative feedback from the three MTs that used the system.

Findings

Since the project mostly used software that has been used and developed over a number of years at a range of universities, the amount of learning to be gleaned from deploying it in the OU context is limited. The software is clearly robust and can be used in this kind of context.

Additionally, the low level of feedback via the focus groups and surveys means that we are restricted to drawing some high-level conclusions.

The main result is that the MCLIDI project was an outstanding success. As stated above, over 1,500 students used the full MCLIDI solution and a further approximately 500 used the STEM Technical solution that included software developed within the MCLIDI project. Out of these approximately 2000 students 28 students experienced issues interacting with the service. Of these 2 were due to an error in the actual MCLIDI service (a strange configuration error that appeared over the Christmas 2021 period) and the remaining 26 were due to a technical problem with the S397 container. The first issue was quickly fixed, while for the second problem a workaround was released within a week. This means that over a period of 10 months 1.4% of students experienced any kind of issue and 0.1% experienced an issue with the core MCLIDI solution. Overall, this indicates an excellent performance of the system, demonstrating the project's success.

A further marker of the projects success is that it has led to the creation of the Open Computing Lab (OCL), which is aimed at providing the MCLIDI service to any interested module within the STEM faculty. It is used in live production for six modules (TM112, TM129, M269, TT284, TM351, S397) and in the development phase for three further modules (TM352, S385, S226), with significant interest from a number of further module teams.

While the limited data gathers means that we have not had any formal publications, intermediary results were presented at the 2022 eSTEeM conference and the project outcomes have, under the guise of the OCL, also been presented to the C&C and STEM Board of Studies.

Impact

The project has shown an impact on two main areas.

It has successfully shown that using the MCLIDI services lowers the barriers to using software put together by the module team. This is likely to improve the student experience, as students focus on studying the content rather than debugging software setups, although the precise impact is difficult to quantify.

The experience of and services developed within the MCLIDI project form the basis of the Open Computing Lab, which provides the same service to any STEM module wishing to make use of it. This is essentially the clearest endorsement of the project's success that is possible.

For the Open University this represents a significant step forward in providing students with a modern learning experience. However, the solution we deployed relies heavily on existing, open-source software components that have been in this kind of use at other educational institutions for significant amounts of time, thus the overall novelty is limited and the only question is why, as a distance-learning provider, the OU was so late to this kind of provision.

Deliverables

The project had three main deliverables:

1. Modern interface for online teaching delivery (OB1, OB2)
2. Generic containerised delivery infrastructure (OB2)
3. Analysis of the costs associated with the new delivery infrastructure (OB3)

Deliverables 1 and 2 were fully completed and are in live use in the OCL. Deliverable 3 was partly completed. Usage patterns for the MCLIDI project were collected. However, when it became clear that the MCLIDI project

would go live as the OCL, no further work was undertaken on deliverable 3. The reason for this is that the OCL uses physical hardware owned by the OU, thus the cost patterns for an online solution, as used by the MCLIDI project, are of no value.

University approval processes

The appropriate approvals were received under the numbers: HREC/4360/Hall and SRPP/2022/2162.