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Lab-Assist: Enhancing STEM education through online laboratories with real-time support

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Abstract

This paper explores the innovative impact of implementing real-time support within the OpenSTEM Labs (OSL), the Open University's online laboratories. Online laboratories allow students to participate in practical work over the internet, at a time and place of their choosing and provide a rich and interactive learning environment for students engaging in practical STEM activities. However, students may encounter challenges while conducting experiments independently. The aim of the Lab-assist project was to implement real-time support mechanisms within the OSL. The short-term impact involves providing immediate assistance to students conducting remote experiments, particularly benefiting those with disabilities and additional needs. By offering tailored support, the project aims to reduce the attainment gap and enhance student engagement. In the long term, the project seeks to transform the educational experience by fostering a dynamic and responsive support ecosystem. This endeavor aligns with the broader goal of empowering students to excel in STEM studies and reach their academic goals.

Keywords: *distance learning, live support, real-time support, STEM education, online laboratories, OpenSTEM Labs, student engagement, The Open University*

Introduction

The proliferation of online learning, accelerated by factors such as the COVID-19 pandemic, has reshaped the landscape of higher education, necessitating innovative approaches to support students' academic endeavors. Central to effective online learning is the provision of timely assistance, aligning with the principles of self-regulated learning (Zimmerman & Moylan, 2009) and metacognition (Broadbent and Lodge, 2021). While traditional methods such as email and discussion boards are common avenues for seeking help (Kitsantas & Chow, 2007; Koc & Liu, 2016), they often lack synchronous support, posing challenges for students. Live chat technology emerges as a promising solution, offering real-time assistance and fostering a sense of connection between students and instructors. Studies indicate positive perceptions of live chat technology among online learners, highlighting its potential to enhance academic support

mechanisms in higher education. Several studies found that instant messaging increases interactions between students and teachers in higher education (Klein et al. 2018; McInerney & Roberts, 2004), improves the sense of connection (Luo et al. 2017; Robles et al. 2019), and enhances student satisfaction (Luo et al. 2017). Students also appreciate instant messaging's immediate and timely responses (Lauricella & Kay, 2013).

Extended OpenSTEM Labs capabilities to enhance student success: Real-time support mechanisms

The OpenSTEM Labs (OSL) at the Open University (<https://www.youtube.com/watch?v=6S3JFsOAP0I&t=8s>) has emerged as a key strategic asset for the STEM Faculty and University, focussed on delivering authentic, pedagogically sound, practical experiences to students in a distance learning environment ([The OpenSTEM Labs | Faculty of Science, Technology, Engineering & Mathematics](#)). However, students may encounter challenges while conducting

experiments independently, particularly those with disabilities or additional needs. To address this, the Lab-Assist project (Kbaier et al. 2023) proposes the implementation of real-time support mechanisms within the OSL.

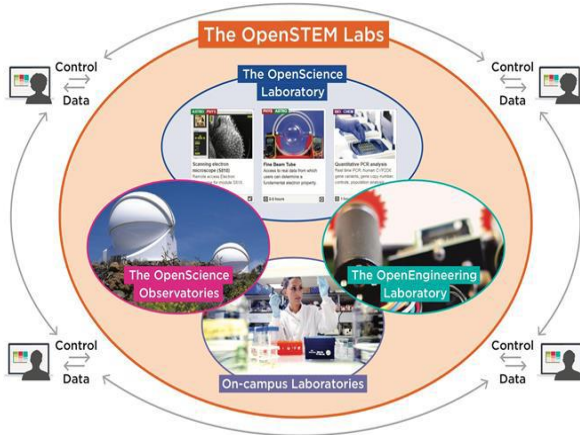


Figure 1: Current OpenSTEM Labs structure illustrating students interacting with remote instrumentation and databases through authentic interfaces, and with each other. Image Courtesy of The Open University.

Insights from module chairs

A survey was carried out with module chairs within the OSL to elucidate the perspectives and requirements regarding the implementation of real-time support mechanisms for students engaging in OSL activities. The analysis of the survey responses from module presentation chairs revealed several key findings:

- Importance of real-time support, particularly for complex activities and those using remote equipment
- Prioritization of assessed and/ or collaborative experiments
- Potential benefits for students with disabilities, anxiety or specific learning environments
- Proposed implementation modalities (live chat, video conferencing, group sessions, pop up messages, special time slots in the booking system)
- The need for improved support mechanisms

Pilot live support for mechanical engineering module (T229 Mechanical engineering: heat and flow)

The Lab-Assist project involves piloting real-time support sessions using Adobe Connect for selected OSL activities (see Figure 2). These sessions offer immediate assistance via live chat and/ or audio to students facing technical issues or challenges during experiments. The support is provided by qualified staff members, including tutors, project specialists,

and lab technicians, who are trained to effectively assist students.

Two pilot trials for live support sessions were carried out in 2023 and 2024, specifically targeting technical issues encountered during experiments in a remote wind tunnel experiment. These yielded limited participation despite proactive advertising and accessibility measures, leading to challenges in collecting comprehensive feedback. However, tutors reported positive engagement with the participating students, indicating that live support may be more effective during initial experiments when students encounter more issues. Suggestions from tutors include offering tailored support based on student feedback and considering the feasibility of pop-up messages to direct students to support sessions. Future iterations may benefit from aligning support sessions with high student booking periods and exploring alternative methods to enhance student engagement. Further modules have been identified for potential live support trials based on the survey feedback from module chairs.

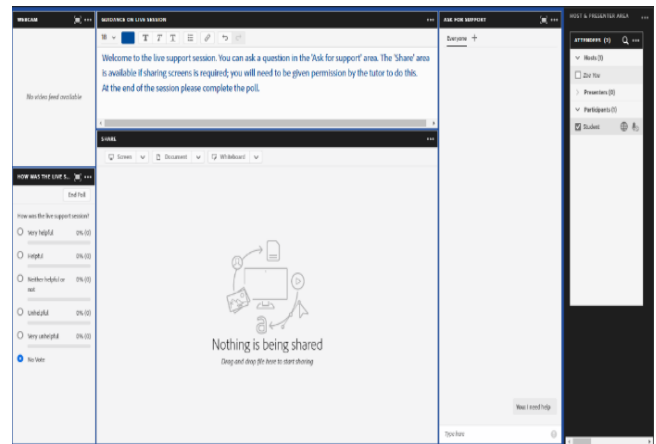


Figure 2: Tutors' Adobe Connect view for live support sessions. Tutors had enhanced privileges, such as admitting students, arranging breakout sessions, and enabling screen-sharing. Students could communicate through chat and voice, with an end-of-session poll included.

Refining the requirements of the live support prototype

To further refine the requirements of the prototype, a second round of surveys were conducted with both students and tutors in June 2023. A total of 41 students and 8 tutors participated, providing valuable insights and feedback. These surveys aimed to gather comprehensive input from both user groups, ensuring that the live support system is tailored to meet the diverse needs and preferences of all stakeholders involved in OSL activities.

Students identified several areas where they believed live support would enhance their experience with OSL experiments:

- Clarifying experimental protocols and measurements
- Assistance with experimental setup and equipment operation
- Receiving feedback on results and interpretation
- Understanding the overall task of an experiment
- Addressing technical difficulties with equipment and data analysis tools
- Importance of real-time assistance during experiments
- Support during the preparation phase
- Guidance on conceptual aspects of the experiments

Approximately 73% of the respondents (30 out of 41) expressed a preference for individual support, while approximately 27% preferred a group setting. The majority prefer using chat for live support (see Figure 4). Opinions on incorporating automated chatbots or AI assistants into the live support system vary. While some express skepticism or disagreement (13 out of 41), others are more open to the idea (12). A significant portion remains neutral (25), indicating a lack of consensus among respondents.

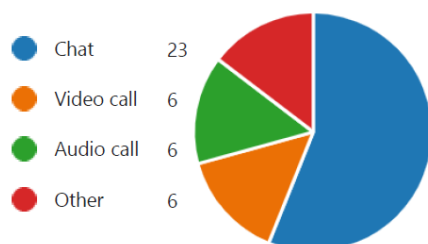


Figure 4: Students' preferred mode of communication for live support during OSL activities (Options: chat, video call, audio call, other).

Several respondents highlighted the importance of implementing specific accessibility features or accommodations in the live support system to cater to students with disabilities or additional needs including:

- Text-to-speech and speech-to-text functionality to assist students with visual impairments or dyslexia.
- Changing the background of the application for better viewing, which could benefit students with visual sensitivities or color blindness.
- Providing options for students to customize the user interface based on their individual needs, such as font size adjustment or high contrast mode.

- Ensuring that the live support system is compatible with screen readers and other assistive technologies commonly used by students with disabilities.
- Offering alternative communication methods, such as audio or video calls, to accommodate students with hearing impairments.

The tutors' survey reveals several common challenges students face during OSL activities. These include difficulties understanding experimental procedures, interpreting results, and managing time effectively. The key benefits of live support identified by tutors include saving time, enhancing understanding, and maintaining student motivation. Tutors currently use various resources like forums, email, and phone calls to support students, with text-based chat being the preferred mode for live support. Tutors emphasize the importance of clear communication, flexible availability, and empathetic engagement in providing effective support. While some express openness to incorporating automated chatbots or AI assistants, concerns remain regarding their ability to provide tailored support and address complex issues effectively.

A prototype system is being developed that features a prominently displayed button that flashes green when live support is available and turns grey when it's not. To facilitate scheduling, live support sessions would be flagged in the booking system, allowing students to choose them in advance when booking experiments. The development of the prototype is ongoing, and we plan to start testing in autumn 2024.

Conclusion

The implementation of real-time support in online laboratories has the potential to significantly enhance student engagement and satisfaction. By providing live support, students' learning experiences and outcomes in online laboratories can be improved. Additionally, real-time support can promote inclusivity by catering to the needs of students with disabilities or additional support requirements.

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