# A classification scheme for OpenSTEM Labs experiments

## Conference or Workshop Item

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# A classification scheme for OpenSTEM Labs experiments

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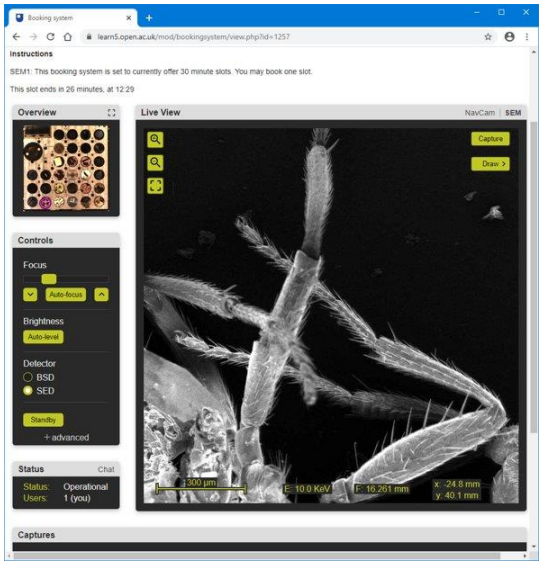
# Overview

- Background to OpenSTEM Labs
- Project aim and objectives
- Classification schemes for remote and online labs from the literature
- Proposed OpenSTEM Labs classification scheme
- Trials using classification scheme
- Initial findings

# Background

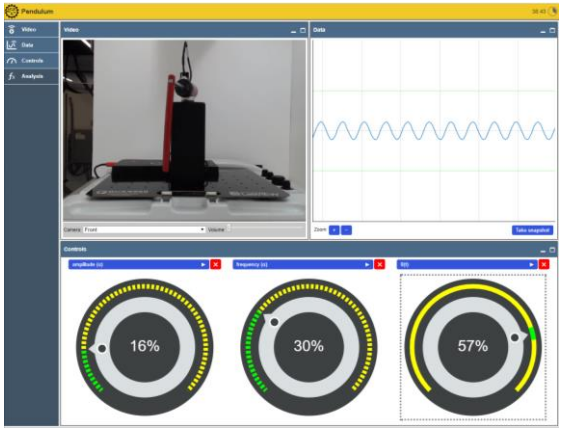
- The OpenSTEM Labs deliver authentic practical experiences to the Open University's distance learning students using real time instrumentation, data and equipment for practical enquiries over the internet
- Students interact with experiments via a web browser on their laptop or mobile device.
- The OU has developed more than 100 activities that are used by more than 10,000 students/year

# Example OpenSTEM Labs activities

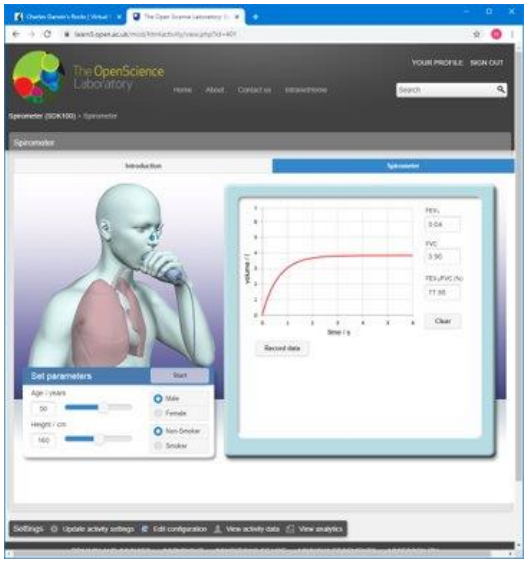



Scanning Electron Microscope

OpenScience Observatories




Controlling a driven pendulum




Spirometer

# Project aim and objectives

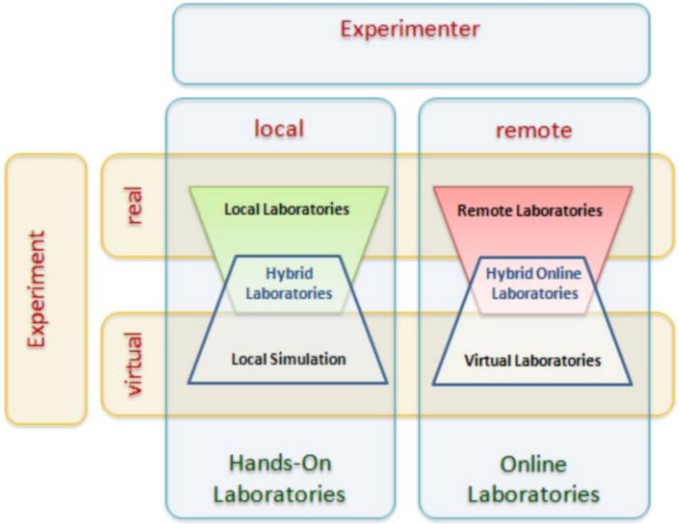
**Aim**:

To explore the breadth of activities, skills and educational outcomes developed in OpenSTEM Labs experiments and develop a learning design tool to inform future OpenSTEM Labs activities.

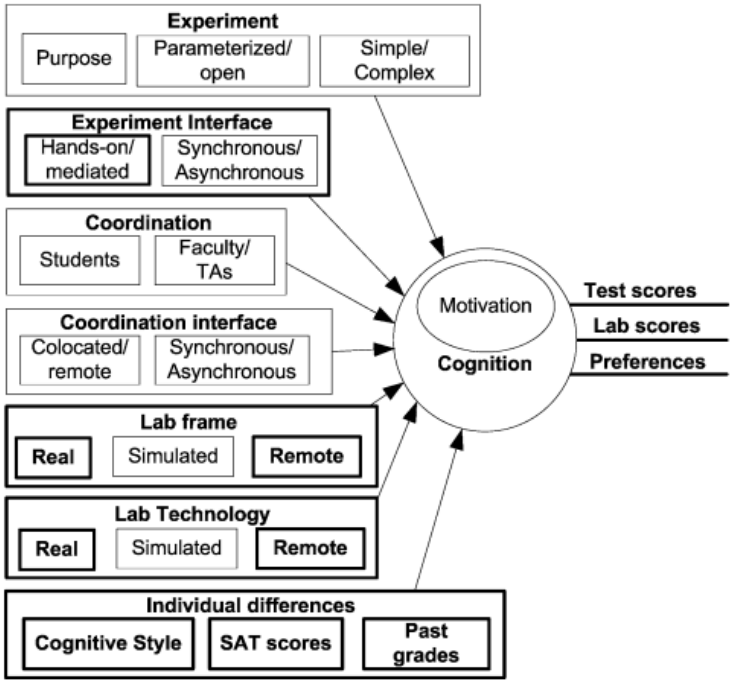
**Objectives:**

- Understand how remote and onscreen laboratories have been classified in the literature
- Develop a classification scheme for OpenSTEM Labs activities and their learning objectives
- Create a database of existing activities to understand the range of activities available and their learning objectives
- Develop a design tool to help module teams developing new OpenSTEM Labs activities

# Classification schemes for remote/ online laboratories




Zutin et al. (2010)




Nickerson et al. (2007)

# Classifications schemes for learning objectives of remote/ online laboratories

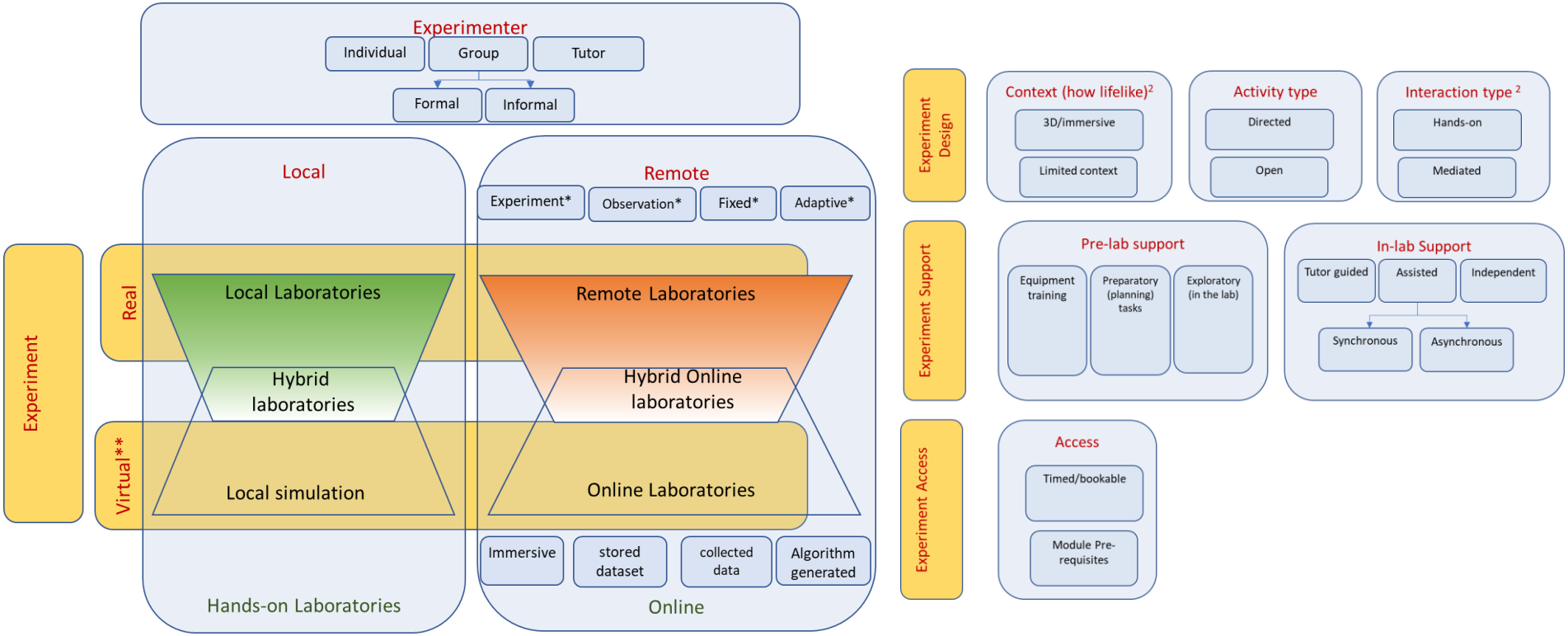
| KIPPAS Learning Outcomes |
| --- |
| Knowledge and Understanding |
| Inquiry skills |
| Practical Skills |
| Perception |
| Analytical Skills |
| Social and Scientific Skills |

Brinson (2015)

| Fundamental Objectives of Engineering Instructional Laboratories | |
| --- | --- |
| Instrumentation | Psychomotor |
| Models | Safety |
| Experiment | Communication |
| Data Analysis | Teamwork |
| Design | Ethics in the Laboratory |
| Learn from Failure | Sensory Awareness |
| Creativity | |

Feisel & Rosa (2005)

# Proposed classification scheme for OpenSTEM Labs activities



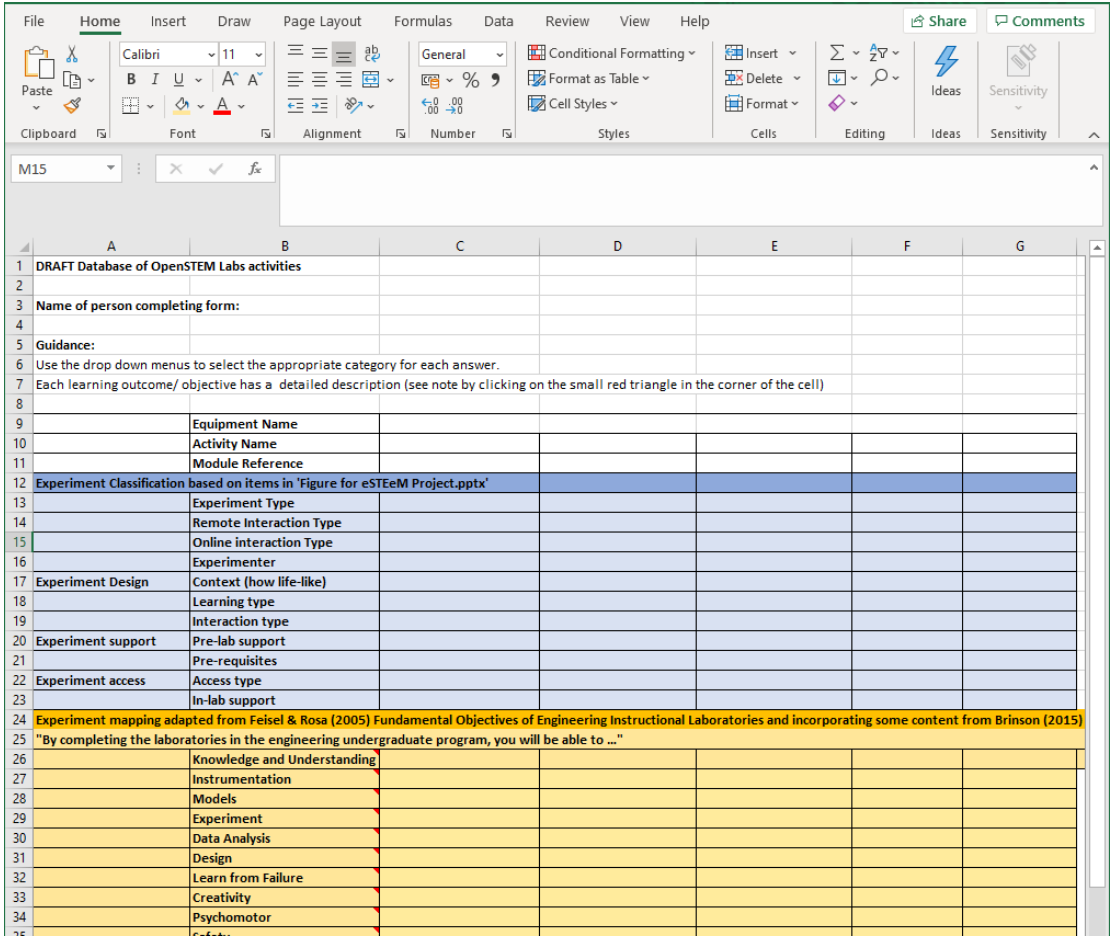

Developed based on Zutin et al. (2010) and others

# Proposed classification scheme for OpenSTEM Labs learning objectives

| | |
|---|---|
| Apply subject knowledge and show understanding | Demonstrate creativity in problem solving |
| Apply appropriate instrumentation to make measurements | Demonstrate competence in operating apparatus |
| Use theoretical models to predict behaviour | Identify and deal with health and safety issues |
| Devise experimental approach | Communicate effectively about laboratory work |
| Collect, interpret and analyse data | Work effectively in teams |
| Design, build, or assemble a product | Behave with high ethical standards |
| Identify unsuccessful outcomes and learn from failure | Use human senses to gather information |

Based on Feisel and Rosa (2005) with adaptations

# Database of OpenSTEM Labs activities

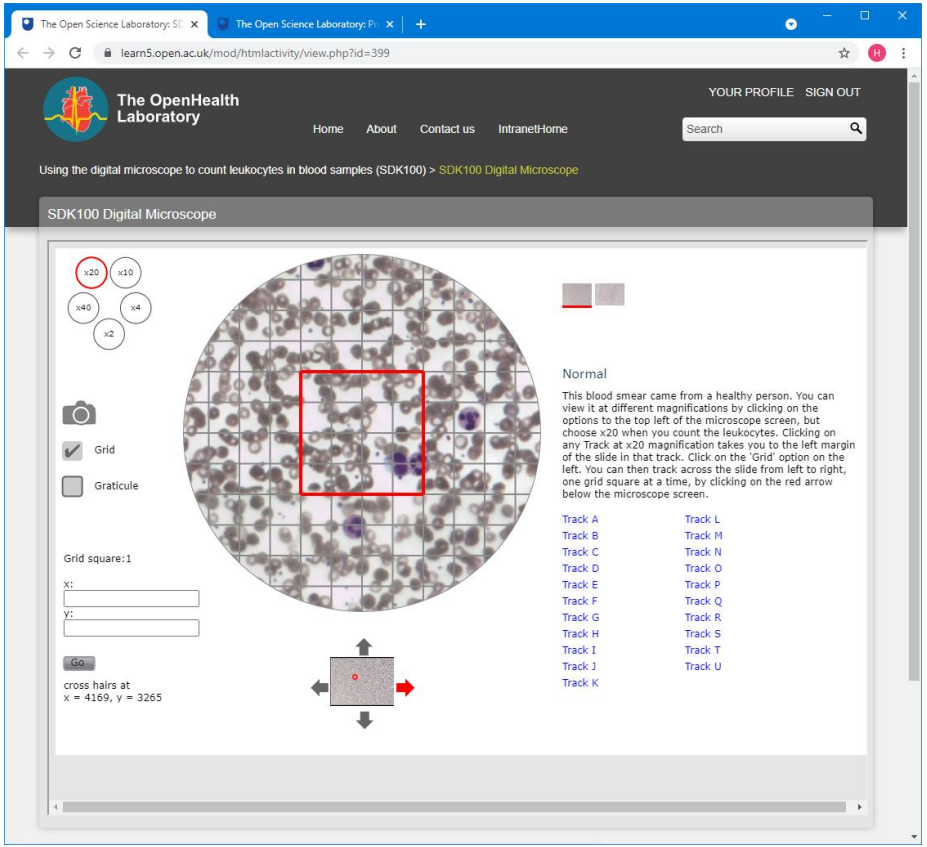


| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | DRAFT Database of OpenSTEM Labs activities | | | | | | |
| 2 | | | | | | | |
| 3 | Name of person completing form: | | | | | | |
| 4 | | | | | | | |
| 5 | Guidance: | | | | | | |
| 6 | Use the drop down menus to select the appropriate category for each answer. | | | | | | |
| 7 | Each learning outcome/ objective has a detailed description (see note by clicking on the small red triangle in the corner of the cell) | | | | | | |
| 8 | | | | | | | |
| 9 | | Equipment Name | | | | | |
| 10 | | Activity Name | | | | | |
| 11 | | Module Reference | | | | | |
| 12 | Experiment Classification based on items in 'Figure for eSTEeM Project.pptx' | | | | | | |
| 13 | | Experiment Type | | | | | |
| 14 | | Remote Interaction Type | | | | | |
| 15 | | Online interaction Type | | | | | |
| 16 | | Experimenter | | | | | |
| 17 | Experiment Design | Context (how life-like) | | | | | |
| 18 | | Learning type | | | | | |
| 19 | | Interaction type | | | | | |
| 20 | Experiment support | Pre-lab support | | | | | |
| 21 | | Pre-requisites | | | | | |
| 22 | Experiment access | Access type | | | | | |
| 23 | | In-lab support | | | | | |
| 24 | Experiment mapping adapted from Feisel & Rosa (2005) Fundamental Objectives of Engineering Instructional Laboratories and incorporating some content from Brinson (2015) | | | | | | |
| 25 | "By completing the laboratories in the engineering undergraduate program, you will be able to ..." | | | | | | |
| 26 | | Knowledge and Understanding | | | | | |
| 27 | | Instrumentation | | | | | |
| 28 | | Models | | | | | |
| 29 | | Experiment | | | | | |
| 30 | | Data Analysis | | | | | |
| 31 | | Design | | | | | |
| 32 | | Learn from Failure | | | | | |
| 33 | | Creativity | | | | | |
| 34 | | Psychomotor | | | | | |

# Trial Classification – Using the digital microscope to count leukocytes in blood samples (SDK100)

| Experiment Classification (examples) | |
|---|---|
| Experiment Type | Virtual |
| Interaction type | Stored dataset |
| Learning type | Directed |
| Access type | Open |

| Learning Objectives (examples) |
|---|
| Apply appropriate instrumentation |
| Devise experimental approach |
| Collect and analyse data |
| Communicate effectively |
| Use human senses to gather information |



# Trial Classification – Investigating strain in a thick-walled pressure vessel (T272)

| Experiment Classification (examples) | |
|---|---|
| Experiment Type | Remote |
| Interaction type | Experiment |
| Learning type | Directed |
| Access type | Bookable |

| Learning Objectives (examples) |
|---|
| Apply appropriate instrumentation |
| Use theoretical models |
| Collect and analyse data |
| Identify health and safety issues |
| Use human senses to gather information |

# Initial findings

- Literature review has helped us to understand the types of remote and onscreen experiments used in Science and Engineering and their learning objectives
- A classification scheme for OpenSTEM Labs activities has been developed
- Initial trials of the classification scheme show how it could help module teams to identify existing OpenSTEM Labs activities for reuse or adaptation to other modules
- Results provide a starting point for a design tool to help module teams developing future OpenSTEM Labs activities

We welcome your feedback!

# Questions?

# References


1. Feisel, L. D. and Rosa, A. J. (2005) ‘The Role of the Laboratory in Undergraduate Engineering Education’, *Journal of Engineering Education*, 94(1), pp. 121–130.
2. Brinson, J.R. (2015) Learning outcome achievement in non-traditional (virtual and remote) versus traditional (hands-on) laboratories: A review of the empirical research. *Computers and Education*, (87), pp. 218–237.
3. Nickerson, J.V., Corter, J.E., Esche, S.K. and Chassapis, C., 2007. A model for evaluating the effectiveness of remote engineering laboratories and simulations in education. *Computers & Education*, *49*(3), pp. 708-725.
4. Zutin D.G., Auer M.E., Maier C., and Niederstatter M., “Lab2go – A repository to locate educational online laboratories,” in Proc. of IEEE EDUCON 2010 Conference: The Future of Global Learning Engineering Education, Madrid, Spain, 14-16 April 2010, IEEE, pp. 1741-1746.