ESTEEM
THE OU CENTRE FOR
STEM PEDAGOGY

A classification scheme for OpenSTEM Labs experiments

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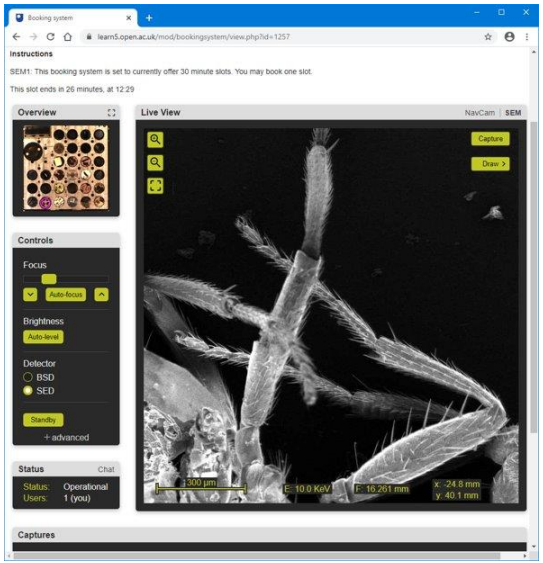
Overview

- 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

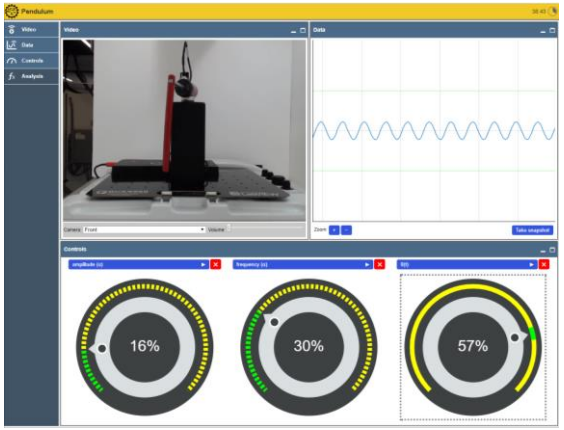
- The OpenSTEM Labs deliver authentic practical experiences to the Open University's distance learning students using real time instrumentation, data and equipment for practical enquiries over the internet
- Students interact with experiments via a web browser on their laptop or mobile device.
- The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

Example OpenSTEM Labs activities

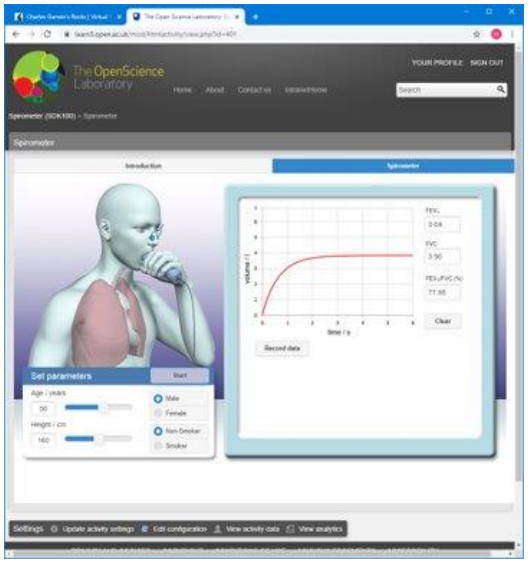


Scanning Electron Microscope

OpenScience Observatories



Controlling a driven pendulum



Spirometer

Project aim and objectives

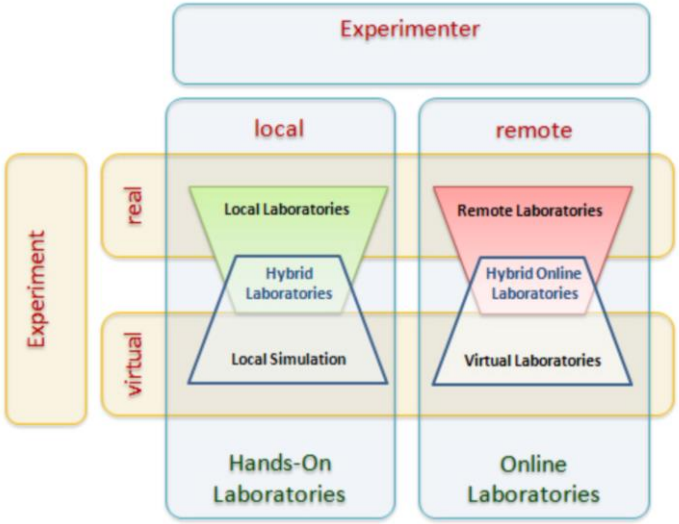
Aim:

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.

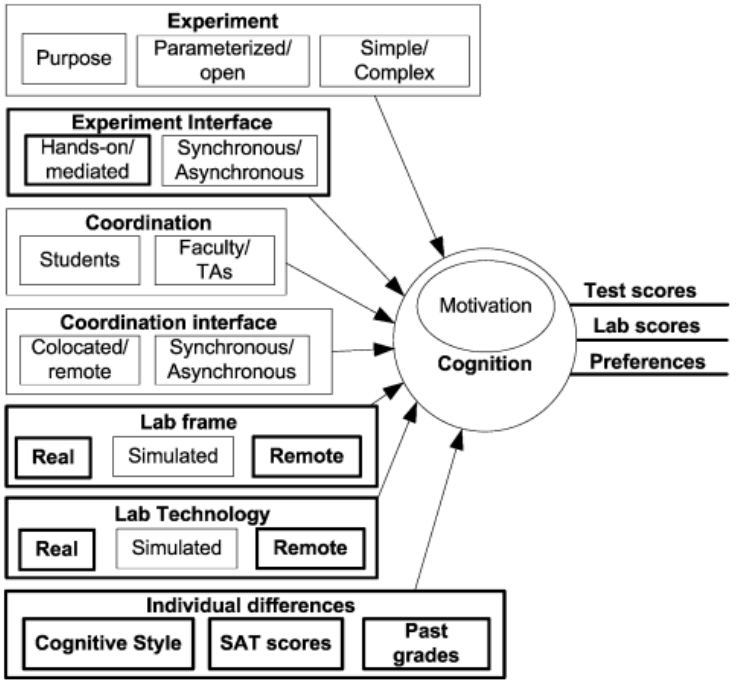
Objectives:

- 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

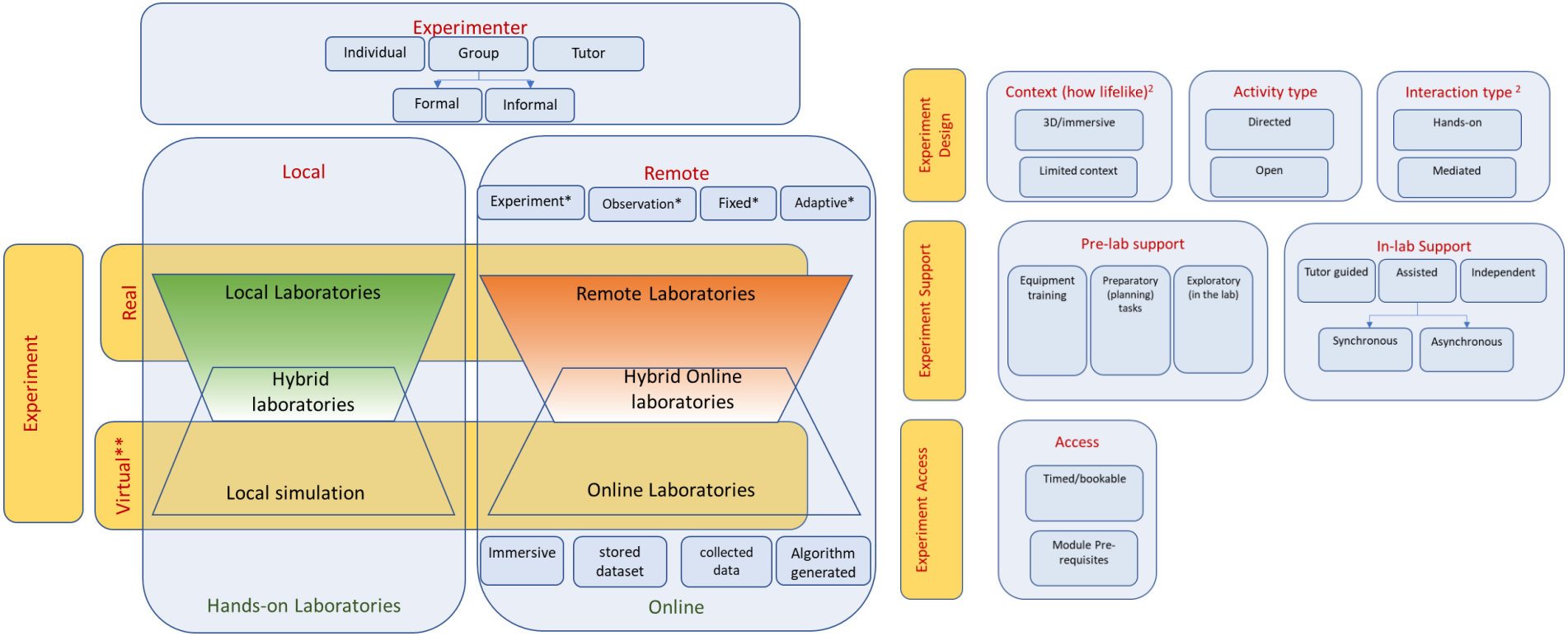
KIPPAS Learning Outcomes
Knowledge and Understanding
Inquiry skills
Practical Skills
Perception
Analytical Skills
Social and Scientific Skills

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



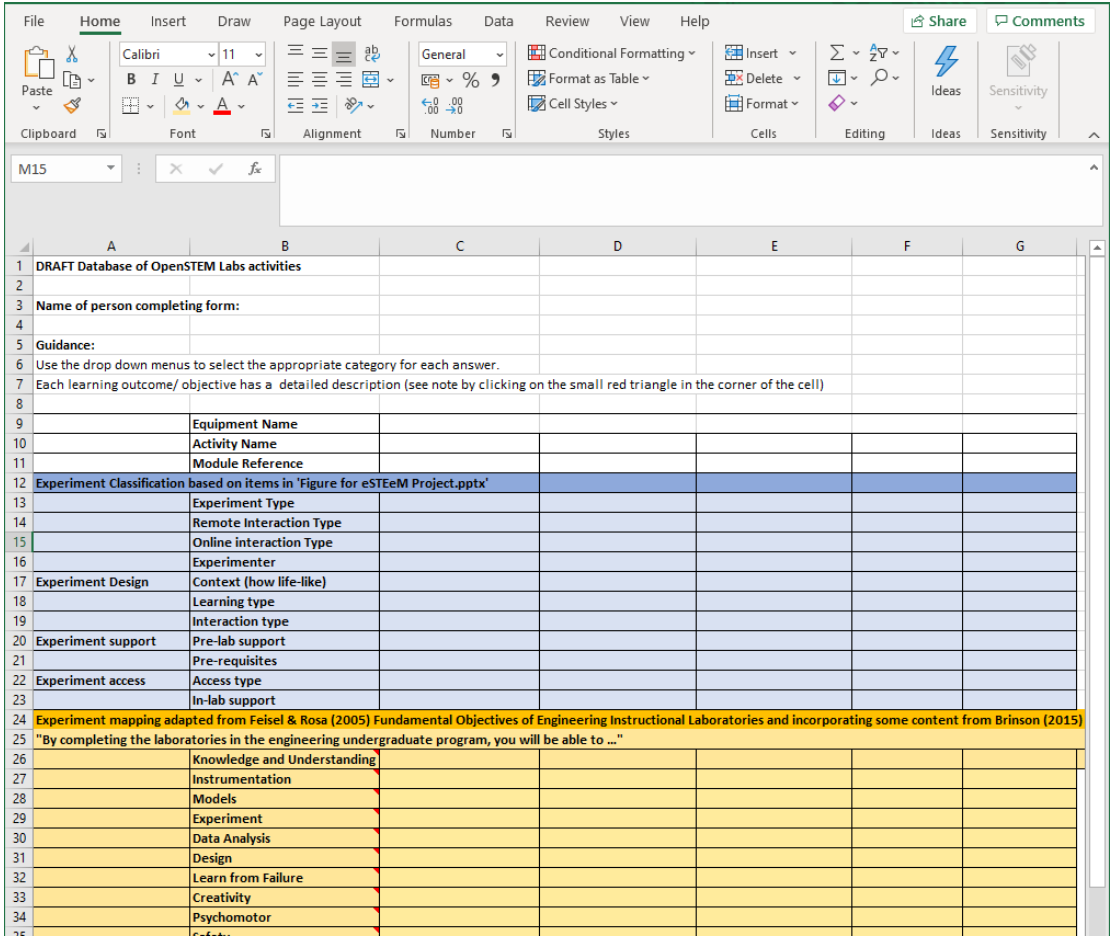
Developed based on Zutin et al. (2010) and others

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

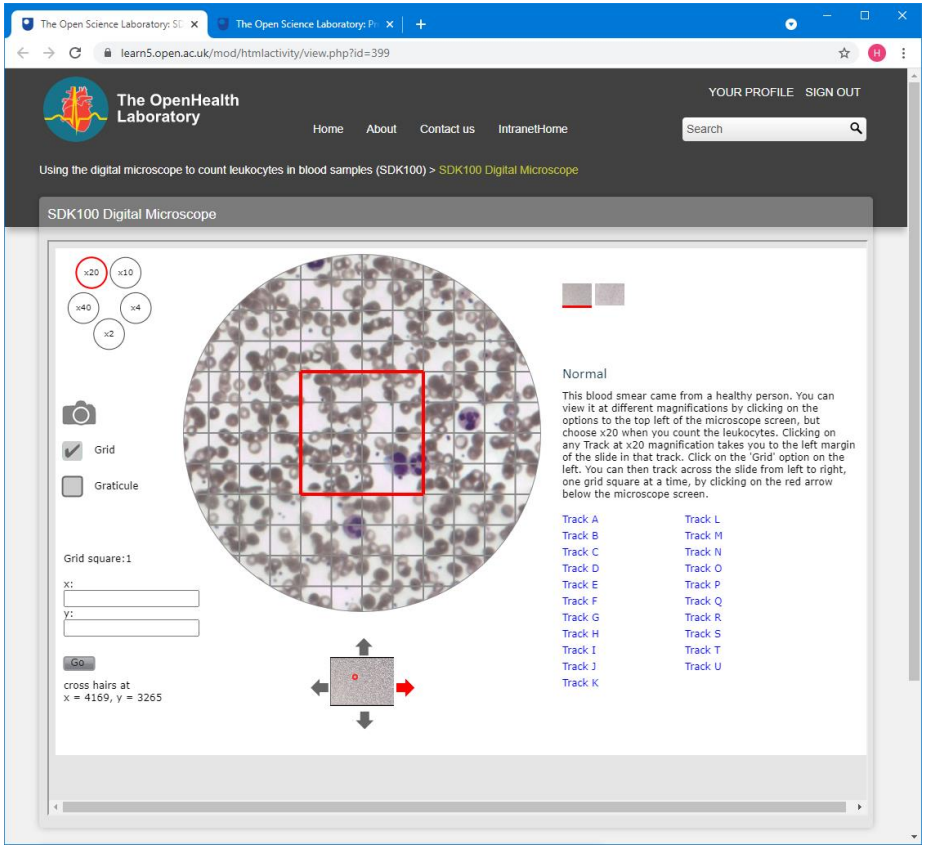


	A	B	C	D	E	F	G
1	DRAFT Database of OpenSTEM Labs activities						
2							
3	Name of person completing form:						
4							
5	Guidance:						
6	Use the drop down menus to select the appropriate category for each answer.						
7	Each learning outcome/ objective has a detailed description (see note by clicking 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.