Clocks as a learning tool  
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Clocks as a Learning Tool

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Optical Engineering & Design Education Research Groups
Loughborough University
Project Background

Laser Made Clock

- Undergraduate Project
- Utilises only Laser Cutting

Benefits of the Technology

- Design Freedoms
- Design for Manufacture
- Design for Assembly
- Fast Manufacturing
- CAD
- Quick Design Iterations

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Integration into Schools

Current Resources

- The production of engaging resources and projects has not kept up with the rapid adoption of CAD/CAM in schools
- Laser cutters are currently used to produce key fobs and book ends, not products with engineering content

Horology Project

- Requires appreciation of modern School environment
- Requires advanced mechanical systems learning and advanced use of technology
- STEM Project with Cross-Curricular Links

http://www.tes.co.uk/teaching-resource/Laser-cut-coaster-and-holder-Task-for-Year-9-CAD-6219611/
http://www.tes.co.uk/teaching-resource/Angry-Bird-Clock-6064643/
http://www.laserprouk.com/laserpro-mercury.htm

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Resources Designed for Schools

Mechanism has been designed for Schools

Product Features

- Incorporation of Science, Maths and Engineering into Design and Technology
- Detailed design of gears, threads, moments, forces and the pendulum motion
- Customisation fulfils the Design in D&T

Optimised For Schools

- Materials and thickness suitable for lower-power lasers
- Ball bearing units replaced with paperclip pins and laser cut holes
- Number of parts significantly reduced
- Pendulum Escapement has been combined

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Resources Designed for Schools

Resource Pack

- Step-by-step guide allows students to assemble independently of the teacher.
- Includes set-up and experiment guide for students for out of school use.

CAD files are formatted appropriately for use on school software.
Pedagogic Models

Experiential Learning

Concrete Experience

Active Experimentation

Abstract Conceptualization

Reflective Observation

Taxonomy of Educational Objectives

Creating

Evaluating

Analysing

Applying

Understanding

Remembering

Teacher Knowledge


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## Development and Testing of Resource

### Focus Groups

- 18 PGCE students from the Loughborough Design School built and critiqued the mechanism.
- Range of interest was distributed as to be expected. Some very enthusiastic.
- All were able to complete the assembly task but not all able to understand the mechanism and investigate its operation.
- Suggested methods for classroom integration and potential issues for pupils

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**Working with the Design Education Research Group to access Local Schools and Teachers**

<table>
<thead>
<tr>
<th>December</th>
<th>January</th>
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<th>March</th>
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<tbody>
<tr>
<td>Development of mechanical timer. Contact with LDS</td>
<td>Creation of resource pack. Planning with schools</td>
<td>Focus group testing. Planning with PGCEs</td>
<td>Interviews with PGCE teachers and mentors</td>
<td>Providing resource support for teachers</td>
<td>Final lesson observations, interviews, and student surveys</td>
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## School Case Studies

<table>
<thead>
<tr>
<th>School 1</th>
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<th>School 3</th>
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| • Year 9 G&T afterschool club with low attendance  
• School would not commit resources to the resource until it had been fully developed and tested  
• G&T pupils participating had excellent performance  
• School produced extra activity resources.  
• Schools had excellent facilities but teachers could not explain technology  
• Students were not pushed to experiment with the mechanism. | • Year 8 curriculum class group projects. Mechanism incorporated into a faculty lesson activity timer  
• Pupils that normally do not perform well in D&T were really engaged in the project  
• Enthusiastic student presentations showed understanding of terminology and mechanism  
• Unable to access and learn about the laser  
• Did not perform experimental mechanism testing | • Year 9 curriculum class individual project.  
• Issue with pupils having already selected GCSE options.  
• Teacher struggled with technical content.  
• Pupils responded positively but had poor understanding of what they had built  
• School had purchased a new laser cutter, but nobody could use it.  
• Students had exposure to laser cutter but no knowledge. |

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Conclusions

- Positive feedback from the students, with 89% approval. 44% would like to do more STEM projects. 42% would like to now build their own clock.
- The year 8 group from School 2 showed the most significant results.
- Broad spectrum of different ability pupils found interest independently from the teacher.
- The teachers knowledge is the limiting factor in all 3 schools.
- Teachers are coming from a non technology background.
- Resources must also be tailored to teachers.
Online Knowledge Base – clocks.lboro.ac.uk

- Collaboration with the British Horological Institute, Worshipful Company of Clockmakers and National Maritime Museum to develop online knowledge base
- A resource to pull children through into engineering by providing them with access to appropriately formatted expert knowledge
- Company sponsored competitions to encourage STEM activities in schools
- Use for pupils in research activities for their projects
- Links between schools and local industry experts to act as STEM ambassadors

Larger Teacher Training Project

- Currently in talks with the Royal Academy of Engineers and Laser Manufacturers to develop an engineering and technology teacher training program to be run at Loughborough University
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