USING LEGO RACE CARS IN THE PHYSICS LAB

Maria Parappilly[a] and Stephanie Mayes[a]

Presenting Authors: Maria Parappilly (maria.parappilly@flinders.edu.au), Stephanie Mayes (stephanie.mayes@flinders.edu.au)
[a]College of Science and Engineering, Flinders University, Adelaide 5001 SA, Australia

ABSTRACT

Students often find learning about uncertainties dry and boring. In order to engage students and simulate their interest, I have been using LEGO race cars to teach measurement more fun while allowing them to quickly repeat their experiments. Students can then perform uncertainty propagation calculations. My research found that these hands-on LEGO activities were instrumental in improving students' confidence with physics experiments, especially in dealing with uncertainties. LEGO lab was also a key factor in reducing the early attrition rate at the first-year level.

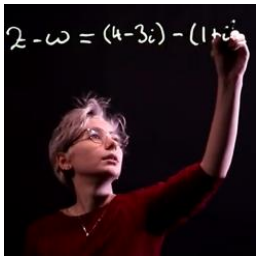
The Experimental Activities that I have designed cover a range of topics, including the concept of uncertainty, the number of variables in an experiment, and the fairness of an experiment (i.e., whether the experiment, as designed, biased the result). In each of the experimental tasks fundamental concepts are introduced, including the various formulae for speed, velocity and acceleration, potential and kinetic energy, as well as the calculation of the track angles. Further, uncertainty analysis is introduced and explained for each experiment, with the students being required to identify the sources of the uncertainty (and if it can be determined, the magnitude) and for the quantifiable sources, and then propagate that uncertainty into the final result. For each experiment, the students are asked to discuss the limitations and drawbacks of the experiment and suggest improvements.

In this workshop, I will discuss some LEGO experimental activities that can be used in lab classes, helping students comprehend the quite abstract concept of uncertainty. These activities can be modified and used to teach school students about energy conservation, sources of energy, different types of energy etc.

Intended Audience: Undergraduate and Secondary-School Physics Educators

PRESENTERS

Maria Parappilly is a Professor of Physics at Flinders University with a passion for advancing women in STEM. An award-winning physics educator and a fellow of the Australian Institute of Physics (AIP), Maria was formerly the STEM education research head at Flinders. Maria leads a Federal Government-funded STEM Enrichment Academy for year 9 girls. She is also the academic lead for international student recruitment in the College of Science and Engineering. Maria is making physics accessible, researching the effectiveness of various innovations she implements. Most of her innovations have been evaluated, disseminated, and published and have had a global impact. For example, her LEGO innovation was featured in the Physics World Stories Podcast from the UK in 2020. She shares her expertise on national, international physics education and course accreditation committees. Her findings share effective ways to interest girls in STEM and enrichment interventions that alter perceptions of science being difficult. She founded the STEM: Women Branching Out (STEMWBO) to support their choice of researching and teaching in STEM. Maria has received multiple honours for services to STEM education and women including a Medal of Order of Australia (2020), The 2019 Advertiser Woman of the year- Top Innovator: AIP Education Medal (2018), D2L Innovation in Physics Award (Canada 2017); South Australian Women's Honour Roll (2017) and SA STEM Educator of the year (2015).



Stephanie Mayes is a Flinders University student who has completed her Bachelor of Science (Energy and Advanced Materials) and is currently in her final year of a Master of Teaching (Secondary) degree, double majoring in Mathematics and Physics. She has a passion for engaging women in STEM and has demonstrated the LEGO lab for Undergraduate students at Flinders University.

Proceedings of the IUPAP International Conference on Physics Education, ICPE 2022 5-9 December 2022, page 43, ISBN: 978-1-74210-532-1.