Instituto Politécnico de Viana do Castelo
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# STEAM approach in building automatons: wheels and axles

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# STEM /STEAM

In Portugal, **STEM** and **STEAM** approach focuses on active learning, defended by different authors over decades.

What is active learning? This is when students are actively involved with their hands, minds and hearts (hands-on; minds-on and hearts-on).

STEM and STEAM, more or less adopted in teacher training, have been presented as essential in the teaching of science, technology and, for a longer time, engineering and mathematics (STEM).

The 2030 goals point to the need for more and more schools, whether primary, secondary or higher education, to opt for any of these perspectives, clearly pointing to the STEM curriculum.

# STEM /STEAM

education sciences

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## Solving Problems through Engineering Design: An Exploratory Study with Pre-Service Teachers

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**Abstract:** A possible pathway to achieve disciplinary integration is through the use of the Engineering Design (ED) process, starting with problems in a real context that enable the mobilization of concepts from various disciplinary areas. The study reported in this paper aims to analyze the performance underlying the use of the ED process in solving authentic problems in a STEAM perspective, with future teachers of elementary education. We adopted a qualitative and interpretative methodology, with an exploratory design, where data were collected through participant observation, documents, artefacts and photographic records. The results are discussed, taking into account previous research and the data collected throughout the classes, where future teachers solved a problem task and created an artefact and a poster. Preliminary results show that the participants valued the experience and were actively engaged, showing persistence and motivation in solving the problem in a collaborative way, through the different steps of the ED cycle. This approach constituted an opportunity to favor the establishment of connections between different areas, such as mathematics, sciences or arts, detecting the possibility of integrating previously learned concepts. Difficulties were evidenced in the identification of some underlying mathematical and physical sciences concepts, particularly in the mobilization of an adequate scientific language while arguing and making decisions, or in accurately justifying the need to improve the designed plan.

**Keywords:** engineering design; problem solving; authentic problem tasks; hands-on activity; connections; mathematics education; STEAM education

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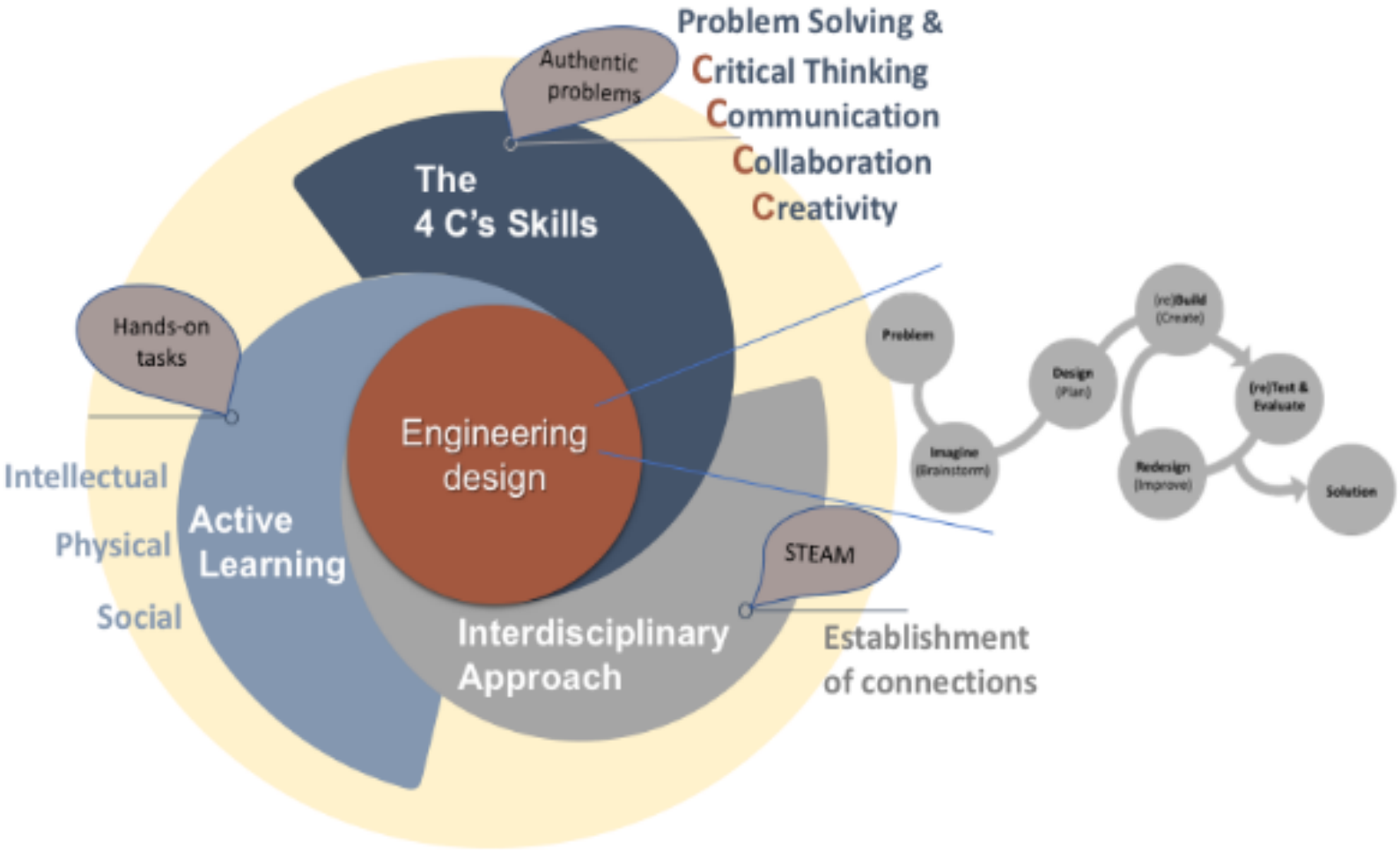
### 1. Introduction

There is a growing emphasis on encouraging creative thinking in education, innovating pedagogies and developing connections among subjects. Tasks focusing on creative processes, rather than concentrating only on achieving solutions for proposed problems, are more relevant nowadays. Therefore, this kind of task is being designed and experienced in school more frequently by innovative teachers around the world. In this scenario, STEAM Education and the disciplinary integration it may provide has been gaining momentum, but the way in which its disciplines should be articulated is still an open debate [1]. A promising approach to attain this integration could be the use of authentic problems, solved through an Engineering Design (ED) process, that require a hands-on (and minds-on) activity, involving students in active learning [2–5].

Taking previous ideas into consideration, in this paper we report an ongoing study, carried out with elementary education pre-service teachers (6–12 years old), that intends to understand and characterize the performance underlying the use of ED in solving authentic problems in a STEAM perspective, during their Didactics of Mathematics classes. In particular, along this didactical experience we want to identify the main difficulties and the main contents mobilized by the participants in solving the proposed problems. To this end, we stated the following research questions: (Q1.) How can we characterize

# Theoretical framework

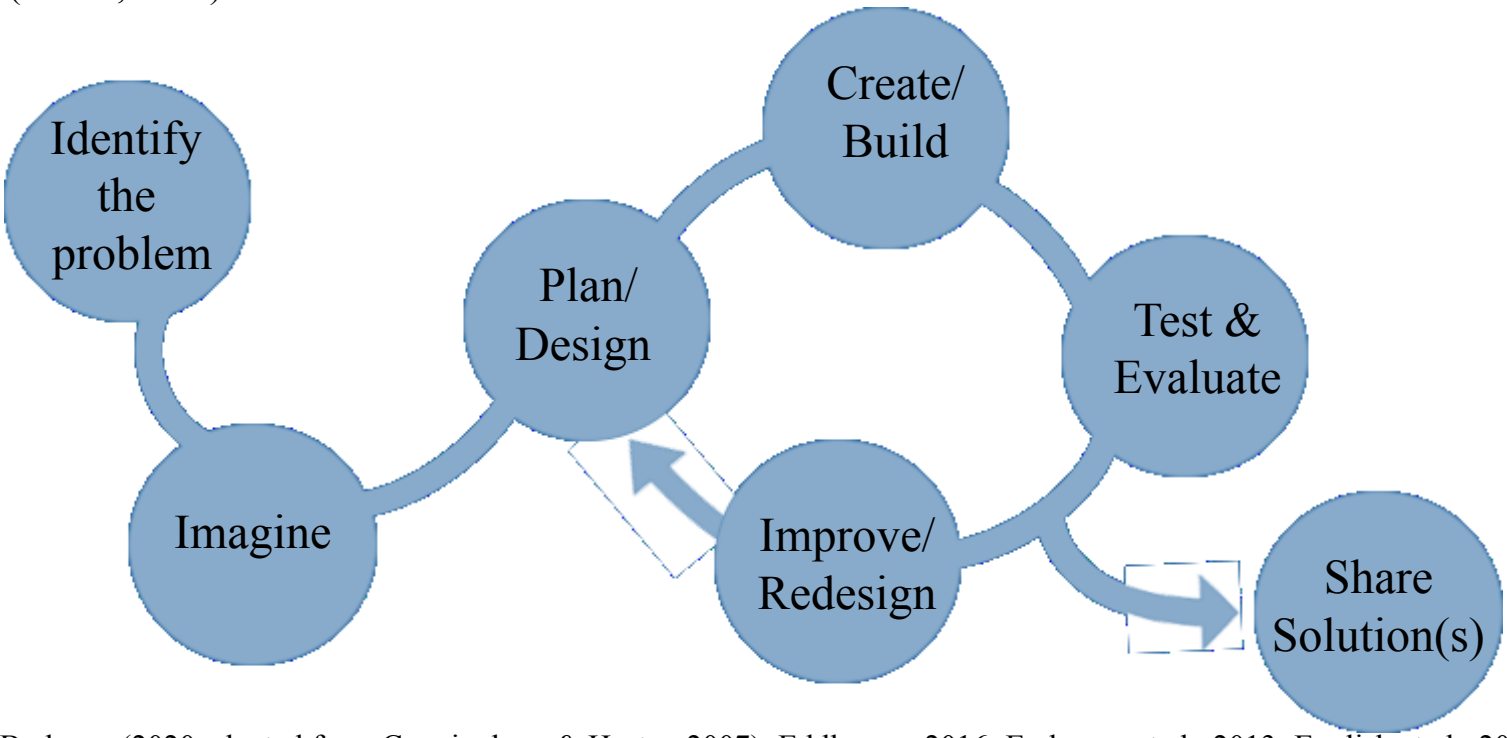


# STEAM approach

Focused on **solving problems**… **how to solve them?** (engineering) … **the science and mathematics** involved in the solving process … **the art**

The 5 steps **(cycle)** Question… Imagine… Plan… Create… Improve… or…

(Schull, 2019)

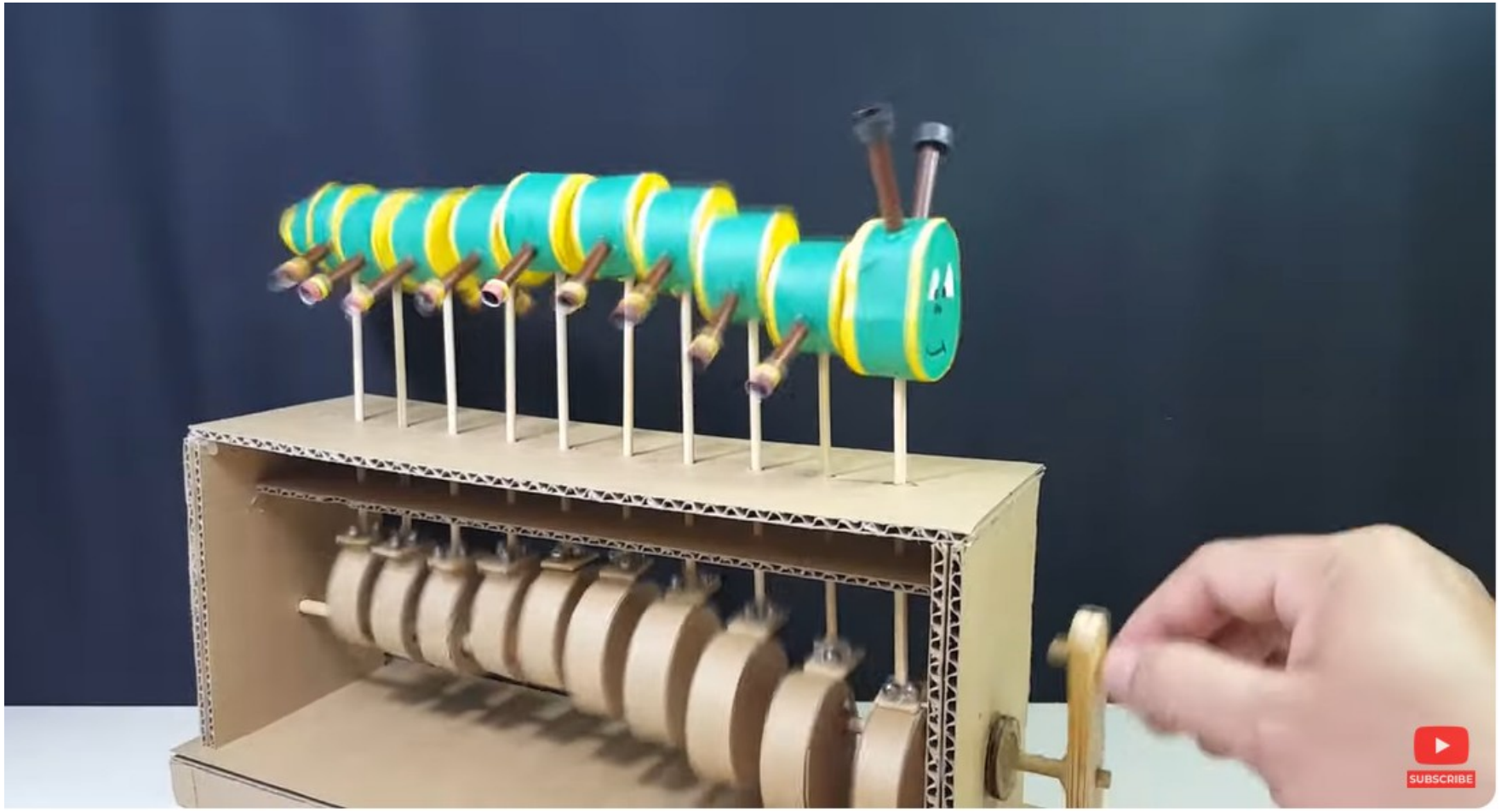



Vale e Barbosa, (2020 adapted from Cunningham & Hester, 2007); Eddleman, 2016; Enderson et al., 2013; English et al., 2015; Stoner et al., 2013; WORKS, 2021)

# The challenge

As a group, try to build the artifact present. To do this, they must follow the engineers' process.

https://www.youtube.com/watch?v=_eKhOqsT898&t=10s



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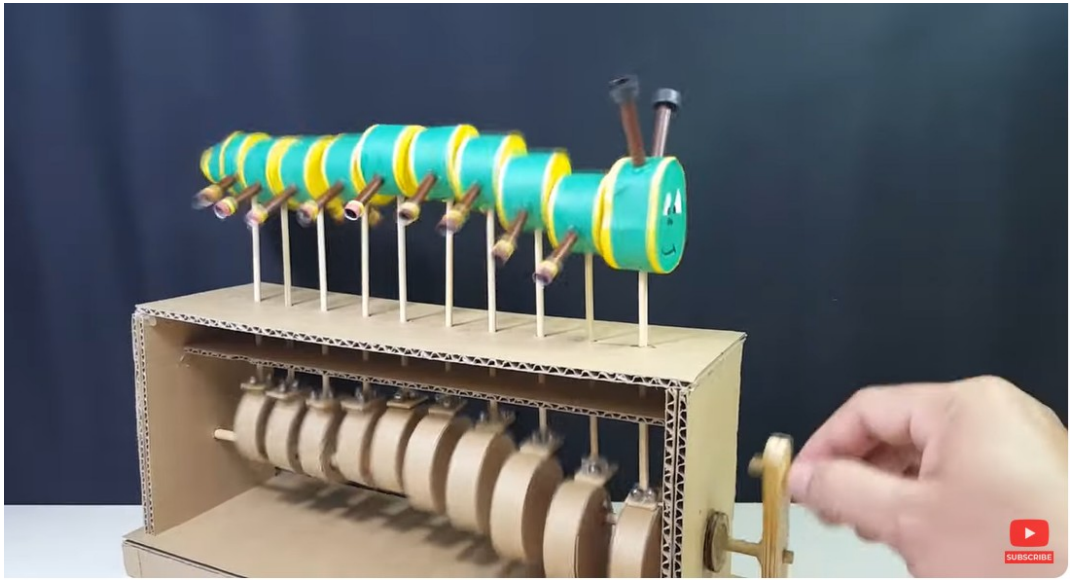

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# Thank you all for your attention!