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AND SUSTAINABILITY

BOOK OF PROCEEDINGS

IWAM 24



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WELCOME

In recent years, the manufacturing processes have undergone a profound transformation, driven by the rapid evolution of additive manufacturing (AM) technologies. What began as a tool primarily for prototyping through stereolithography has now expanded into a versatile and innovative field capable of producing functional, end-use components across a wide range of industries. From fused deposition modeling (FDM) to selective laser melting (SLM) and beyond, AM has unlocked new possibilities in design, material utilization, and production efficiency. Today, additive manufacturing encompasses an extensive array of materials, including metals, polymers, paper, and even biological tissues, enabling applications that span from the mechanical industry to the biomedical sector.

One of the most compelling aspects of additive manufacturing is its potential to drive sustainability in modern production processes. Unlike traditional subtractive methods, which often generate significant material waste, AM builds components layer by layer, minimizing excess material and promoting resource efficiency. Furthermore, the ability to use eco-friendly and recyclable materials aligns with global efforts to reduce environmental impact. AM also supports the production of complex, customized parts on demand, reducing the need for large inventories and long-distance transportation, thereby lowering carbon emissions. By optimizing resource use and enabling more efficient production cycles, additive manufacturing is emerging as a cornerstone of sustainable manufacturing practices.

This proceeding book arrests the latest advancements, challenges, and opportunities in the field of additive manufacturing, with a particular focus on its transformative potential and contributions to sustainability. The works presented here reflect the interdisciplinary nature of AM, showcasing innovative techniques, materials, and applications that are shaping the future of manufacturing. From cutting-edge research to real-world case studies, this collection aims to inspire further exploration and collaboration, driving the adoption of additive manufacturing as a key enabler of sustainable industrial progress. We invite readers to probe into these pages and discover how AM is not only redefining manufacturing but also paving the way for a more sustainable and efficient future.

The IWAM 2024 Organizing Committee,

João Rocha

João E. Ribeiro

Jorge Santos

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TABLE OF CONTENTS

<i>Process Optimization of a Green Composite Containing a 3D Structure Produced via Additive Manufacturing</i>	11
<i>Artificial Intelligence for Additive Manufacturing: preliminary analysis of trends and challenges</i>	15
<i>Experimental Study of Green Nanofluids: Evaluation of Wettability, Viscosity, and Thermal Conductivity Properties</i>	19
<i>Increasing motivation and learning in digital manufacturing: Blended Intensive Programs for STUDENTS</i>	23
<i>3D Print Technologies Applied in Robotics Prototyping</i>	27
<i>Study of Electro Discharge Machining (EDM) to manufacture holes in Selective Laser Melted (SLM) parts.</i>	33
<i>Utilisation of feedstock material in additive manufacturing technology of ceramics by UV laser vat-photopolymerisation (VPP-UVL/C)</i>	37
<i>MEX and VPP-UVL Technologies for Printing Complex Alumina Parts</i>	41
<i>Design of a novel bi-phasic biomimicking auxetic 3d printed structure with fluids that biomimic the hysteretic behaviour of articular cartilage for medical phantoms</i>	45
<i>Developing optical mimicking phantoms of the head tissues – a new approach for transcranial photobiomodulation research</i>	51
<i>Optimization of PDMS Curing in SLA Resin Molds: Techniques and Approaches</i>	55
<i>Valorisation of Olive Mill Wastewaters for Industrial Applications</i>	59
<i>Effects of extensive green roofs on rainwater drainage from a metalworking industry building</i>	63
<i>Strategies for Modifying PDMS Wettability and Potential Applications</i>	74
<i>Microfabrication of a capillary-driven microfluidic device: Surface wettability</i>	78
<i>Microfabrication of a capillary flow-driven microfluidic plasma separator</i>	83
<i>Development and fabrication of a microfluidic device for mechanical characterization of malaria-infected red blood cells</i>	88
<i>3D Hollow microneedles fabrication for microfluidic applications</i>	92
<i>Linear transformations in an engineering course – Matrices and dynamic representations</i>	100
<i>Awareness of sustainability practices in construction: Learning in a real context</i>	104
<i>Acoustic stimulation based on piezoelectric materials enhanced anti-proliferative activity of triple-negative breast cancer cells</i>	108
<i>Study of the effect of the physical characteristics of bacterial nanocellulose on the proliferation of triple negative breast cancer cells</i>	112

Collaborative work between Polytechnic Higher Education students: Manufacturing processes, Safety and Sustainability..... 116

Learning linear algebra with the MathE platform: an experience in a Mechanical Engineering course 120

Enhancing Realism in 3D Mapping Through Drone-Based Photogrammetry and Animated Elements..... 124

A Review of Best Methods for 3D Scanning and Modeling of Terrain and Buildings Using Drones and Photogrammetry..... 130

Mechanical analysis of specimens generated by 3D topological optimization 135

Collaborative work between Polytechnic Higher Education students: Manufacturing processes, Safety and Sustainability

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ABSTRACT

The link with the real working environment, combined with the sharing of knowledge and collaboration between students from different courses, was the basis of a teaching experience involving students from the Mechanical Technology I course unit of the Mechanical Engineering degree course and the Safety and Environment course unit of the Higher Professional Technical Course in Sustainable Technologies in Mechanics and Vehicles, at a Polytechnic Higher Education Institution in the north of Portugal. The final objective was to carry out collaborative work on metalworking processes, the safety at work related to these processes, and waste management.

Keywords: Collaborative work, mechanics, safety, environment, higher education.

INTRODUCTION

In Higher Education, at least since the Bologna process, teachers have been challenged to promote students' autonomy and to help them assume the role of protagonists in the teaching-learning process (Caballero & Bolívar, 2015). Barbosa and Moura (2013) believe that active learning occurs when students interact with the subject under study - listening, speaking, questioning, discussing, doing, and teaching - and are encouraged to construct knowledge rather than passively receiving it from the teacher.

Adding to these assumptions the importance of students experiencing difficulties in an environment that is as close as possible to the professional reality of the course they are taking (Mendes, 2015; Silva, Ribeiro & Barros, 2019, 2021, 2022), a teaching experience was implemented that focused on collaborative work between students at different levels of their academic journey. One group was taking the Mechanical Technology I course unit as part of the Mechanical Engineering degree course, and the other was taking the Safety and Environment course unit as part of the Higher Professional Technical Course in Sustainable Technologies in Mechanics and Vehicles at the School of Technology and Management of the Polytechnic Institute of Bragança.

The work was carried out in groups, including students from both courses and concerned metalworking processes, the safety at work associated with these processes, and waste management. In this way, the students played the role of “experts” in their field, contributing to the work with the knowledge acquired in their respective course units and generating knowledge together (see, e.g., Rao, 2016; Aronson, 2000; Matias, Masulck & Schneider, 2020). A study visit to a foundry and a seminar on sustainability in the metalworking industry with students from both courses further supported this.

RESULTS

Once the collaborative work was completed, the students presented it to their colleagues. This process took place in two stages, as each group produced two pieces of work, and the topics for the second piece of work were not assigned until after the first presentation session.

This division into two stages was based on the content of Mechanical Technology I, which aims to help students acquire knowledge of two major groups of metalworking processes. Thus, in Stage I, the topics assigned were related to casting manufacturing processes, and in Stage II, to metal plastic forming manufacturing processes.

Figures 1-(a) and (b) show some extracts from the work produced for each stage.

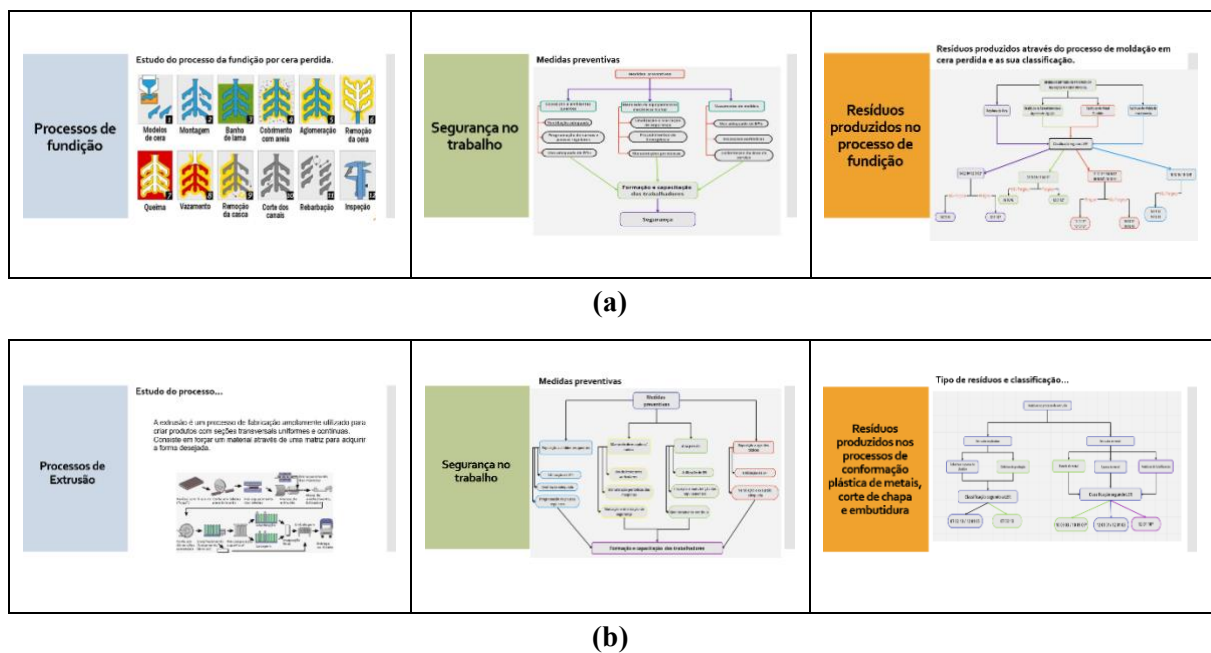


Figure 1 - Extract of work from stage 1 (a) and 2 (b).

Regardless of the topic or process being studied, the work followed a similar structure at each stage, as shown in Figure 1. First, the students presented a brief description of the process related to their topic. Next, they analyzed the hazards, risks, and preventive measures associated with the process. Finally, they analysed the types of waste produced, their classification, and explored possible methods of reduction or reuse depending on the context.

All the groups completed their work and addressed all the necessary components, although the depth of the descriptions and analyses varied among the groups.

Based on their status as participant observers (Gómez, Flores & Jiménez, 1999), the class teachers noted initial difficulties developing collaborative work in some groups. Students tended to work only with the students on their course, trying to develop the part most directly related to their course unit. However, the proposed work involved linking the different components, which meant that students had to make an effort to collaborate more actively and to debate opinions to achieve the planned objectives.

Therefore, to make the learning more meaningful, after the first assignments had been completed and presented, the students were asked for possible suggestions to improve the second-stage assignments, and the suggestions were discussed in class.

In addition to suggestions for enhancing the theoretical aspects of the work and making the presentation materials more appealing and organized, this debate sparked a discussion about the attitudes and behaviors of both presenters and the audience during presentations. As a result, it was decided that it would be more motivating and beneficial for the students themselves to moderate the second presentation session.

CONCLUSIONS

Reflecting on the difficulties and discussing suggestions for improvement in the realization and presentation of the work played an important role in the student's performance in the second assignment. We believe that this type of experience is always beneficial for students, both in terms of building knowledge and developing transversal skills, such as the ability to communicate and collaborate with peers: "It was an enriching experience, working in a group made me improve my team spirit as well as my presentation skills"; "I think it was a positive experience that enriched our knowledge and taught us how to collaborate between classes".

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