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Assessing student learning of design and project management skills in a project-based course

The design process followed by mechanical engineers is undergoing significant changes with the development of rapid prototyping techniques [1] and of artificial intelligence (A.I.) supported tools [2]. The job market is highly affected by these changes. However, Deininger et al. [3] show that novice designers do only rarely take advantage of the new tools and if they do, their use is unintentional. There is a clear need for mechanical engineers to be trained to use A.I.-based tools.

Created in 2016-2017, the ME-403 course in "Applied mechanical design" seeks to help students develop both design and project management skills though a highly applied project-based format. In 2018-2019, the course has been modified to include the use of A.I.-based tools: students first experience the traditional design process and then the A.I.-based process with the same set of requirements. This contribution presents the results of a study based on the data collected during normal teaching and learning activities of this course. Indeed, students submit several group reports, which include design process information, design data (chosen components and dimensions) as well as project management related information. In addition, students answer a "Project Management Skills" questionnaire at the beginning and at the end of the course to get feedback on their skills in five project-management domains (planning, risk-assessment, ethical sensitivity, communication and interprofessional competence). Because the course is currently running, we cannot summarize the findings yet, but we intend to report on:
- The evolution of students' project-management skills, using the pre-post responses to the questionnaire and project-management information extracted from students reports;
- The evolution of students' design process and performance between the traditional and A.I.-based parts of the project, using design information extracted from students reports.

Finally, we will describe how these results will inform the teaching of the course for the next occurrence.

[1] Jensen M. B., Elverum C. W., Steinert M. (2017). "Eliciting unknown unknowns with prototypes: Introducing prototrials and prototrial-driven cultures", *Des. Stud.* vol. 49 (Mar. 2017): 1–31.
[2] Rigger E., Shea K., Stankovic T. (2018). "Task categorisation for identification of design automation opportunities", *J. Eng. Des.* vol. 29 (Mar. 2018), no. 3: 131–159.
[3] Deininger M., Daly S. R., Sienko K. H., Lee J. C. (2017). "Novice designers' use of prototypes in engineering design", *Des. Stud.* vol. 51 (Jul. 2017): 25–65.