## Flower Kinetic Sculpture: Modified EDP For K12 Students' Prototyping Method

In recent years, students were only able to work on their skills online. So while proficiency in CAD (Computer-Aided Design) persisted, no work could be done with manufacturing **tangible** prototypes, causing the ensuing issues.

Student makers have trouble incorporating real-life constraints into their designs and fail to think of them during the design process, bypassing any relevant physics knowledge that should be thought of. Steps that are implied in traditional **EDP** (Engineering Design Process) are also disregarded because of students' lack of experience [3]. Other vital skills like estimating engineering quantities are similarly **underdeveloped** due to a lack of hands-on experience [4].

As a student, I propose a modified EDP that is targeted toward student-makers facing these difficulties. A method that aims to utilize the familiarity with CAD [7] engines most student makers gained to bridge the gap of the lack of hands-on experience, and to integrate **high-fidelity** [1] prototypes within the CAD environment at the student level. As a proof of concept, I've designed and manufactured an automaton, **a blooming flower kinetic sculpture** to be exact, which was developed with the proposed EDP.

In the proposed EDP the research stage is modified to explicitly include a stage for identifying relevant practices or principles and understanding them pertaining to fields such as physics, math, chemistry, and such. The modified EDP expands the design requirements and brainstorming stage into systematic problem decomposition [3] where either a breadth-first or depth-first approach is used according to the problem. The students' high-fidelity model is used as a pre-preliminary design, allowing testing and optimization prior to the first tangible prototype [7]. After identifying problems in the preliminary, modifications are made directly to the prototype, and the problem is recomposed with each recomposition iterating the aforementioned steps. The modified EDP puts emphasis on the development of supports, frame, and base and is another stage with its own EDP iterations.

***Keywords*** *Engineering Design Process, Computer-Aided Design, Computer-Aided Manufacturing*

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*References*

[1] Hannah R., Joshi S., Summers J.D. (2012) *A user study of interpretability of engineering design representations*, Journal of Engineering Design, 23:6, 443-468, DOI: 10.1080/09544828.2011.615302

[3] Song T., Becker K., Gero J., et al. (2016) *Problem Decomposition and Recomposition in Engineering Design: a Comparison of Design Behavior Between Professional Engineers, Engineering Seniors, and Engineering Freshmen*, Virginia Tech Publishing, 27:2, DOI: 10.21061/jte.v27i2.a.3

[4] Linder B.M. (1999) *Understanding Estimation and its Relation to Engineering Education*, Massachusetts Institute of Technology

[7] Ahmed S., Wallace K. M., Blessing L. (2003) *Understanding the differences between how novice and experienced designers approach design tasks*, Research in Engineering Design, 14, 1:11+. DOI: 10.1007/s00163-002-0023-z