Session: Assessment of Design

Exploring the portfolio assessment on novice engineering students' creativity, design and implementation process - setback event based analysis

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Setback event based analysis was proposed as an effective methodology to evaluate the width and depth of a novice's engineering creativity design and implementation project. Two operational approaches were proposed, through which, the mentality and mental process of novice students working through their creativity realization projects were uncovered. The mental processes of working through engineering analysis, application, and design problems were identified. They could be modeled, respectively, as a functional mapping process, its inverse function, and an inverse functional mapping into the parametric space.

We are developing a program to bring an integrative creative design and implementation experience to undergraduate engineering students who are novice to hand-on works. We found that most of them would be flunked, if their achievements were evaluated by either the creativity and engineering quality of their products or their procedural compliance to that of a professional.

Looking into the engineering journal of these rookies, it were the setback events, instead of progress and achievement, which revealed the insight of their worthy efforts. The journal was packed with setbacks, after setback turning points, compromises, abandonment, and restarts from scratch. Short of knowledge on implementation and practical experience, novice students were tangled by setbacks in both design and manufacturing. Moreover, their ideas were jumping, switching, and withdrawn, instead of going through rational and consistent design iterations from breadth to depth. Therefore, we proposed that the setback events were the clues revealing the critical threads of the novice efforts. Their portfolio assessment should be a setback event based analysis.

We applied two approaches to uncover material characteristics in Setback Event Base Evaluation:

1. "characteristic modal pattern in the Setback Event Count Histogram": Categorize setback events according to corresponding design stages, and the histogram of event count by category would reveal characteristic modal patterns. For example, high counts in both "concept generation" and "material and part" categories represent the students' willingness to acquire market knowledge on materials and parts, the extent of their exploration into new, as well as the depth on their existing, concepts and ideas.

2. "frequency count of Linked Setback Event Sequence": Analyzing the temporal sequence of setback event categories, we can find characteristic linked event sequences, such as "testing - analysis and calculation - specification selection" and "manufacturing - fitting - tolerance design". These sequences reveal the student's difficulties, focuses and efforts.

Through these two approaches, we could capture the insight into the depth of exploration, the product versatility, functionality, quality, and the self-expectation to which the students were committed. Therefore, the Setback Event Based Evaluation greatly enhanced the discriminative power in evaluating a novice creativity, design and implementation experience.