Proposing a Feedback System to Enhance Learning Based on Key Performance Indicators

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ABSTRACT

This paper proposes a feedback system that is based on the self-evaluation of perceived productivity as a mechanism for detecting deviations in an engineering design student project. By monitoring key performance indicators, project members used feedback loops to recognize alarming patterns and act accordingly. The study is based on descriptive survey data that addressed three factors of influence: perceived productivity, perception of stage completion, and work-activity distribution. The productivity data was analysed by detecting patterns in the form of peaks and lows and by combining the patterns with qualitative data from observations and documented work activities. Measurements were taken every time the project team got together; 33 occasions during the course of the project, resulting in a total of 280 student responses for productivity (P) and completion (C) and 115 student replies for work activity distribution. The findings provide an extraction of peak values and low values that enables tracking of critical incidents. Through an in-depth activity log, each value was enriched with lessons learned about what took place and the consequences for the project, thus enhancing learning from past activities through systematic feedback sessions. The accumulated set of data provided distinguishable patterns for the project team to interpret. Over time this made student actions more proactive, activity execution more distinct and purposeful, and resource allocation in combination with feedback reflections more refined.

Keywords: Design Project, Efficiency, Feedback, Key Performance Indicators, Mapping, Productivity

INTRODUCTION

Today, engineering design projects form an integral part of many universities’ master’s programs (Dym et al., 2005). Although these projects seek to foster the pragmatic skills involved in establishing new products or services, little emphasis has been put on tracking the rollercoaster of activities that project members experience. Viewing what takes place from

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the perspective of process allows for a deeper understanding of how resources are allocated and acted upon within the project group. This paper presents a self-tracking feedback system that promotes efficiency and detects problem areas for engineering designers as they engage in designing new, innovative products. The paper discusses the impact of continuous self-evaluated productivity, the meaning of patterns detected, and what causes these patterns in an engineering design project so that project groups can learn from past mistakes through continuous reflection.

Project-based learning can help “students acquire a high rate of actual skill and technical learning” (Debnath & Pandey, 2012, p. 46). Past studies have placed great attention on the importance and implications of project-based learning (e.g., de Graaf & Kolmos, 2007; Blumenfeld et al., 1991; Debnath & Pandey, 2012), yet have failed to pay similar attention to details that could strengthen the learning efficiency of such projects. In an overview of existing literature in the field of engineering education, we find that student engineering design projects rarely use productivity evaluations or similar process measurements. Self-evaluation is a form of self-efficacy, which is described as a measure of a person’s own ability to complete tasks and to reach goals (Ormrod, 2006). For the purpose of this research a self-evaluation measure has been used to detect project deviations in order to maintain high productivity and minimize disturbances. This research offers a first step towards measuring success in student design engineering projects through the self-evaluation of students’ perceived productivity. Productivity for this purpose refers to the output of quality work, given a certain input; it is not a ratio between a quantity and a time unit. This study combines self-evaluation and productivity in the sense that the team members themselves evaluated how productive they felt the entire team was during the workday. Carbarry, Lee and Ohland (2010) have been able to provide a link between self-efficacy and productivity in engineering design projects.

The application of metrics in design projects facilitates better follow-up and improved planning of upcoming projects (Xijuan, Yinglin & Shouwei, 2003). Measuring productivity could be beneficial by aiding in project monitoring, facilitating better project planning and helping set benchmarks (Ramírez & Nembhard, 2004; Brewer & Mendelson, 2003). Furthermore, self-assessment of team performance has a positive association with the project outcomes, as it strengthens the relationship between the importance of the process and the outcome-related nature of the project (Palmer & Busseri, 2000). Self-evaluation of productivity is said to improve the planning process and increase communication between team members (Shekar, 2007). Earlier attempts to
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