

# CSCL Opportunities with Digital Fabrication through Learning Analytics

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**Abstract:** This paper presents a recently started research project that aims to generate, analyze, use, and provide feedback for analytics derived from hands-on, project-based and experiential learning scenarios. The project draws heavy influence from digital fabrication activities and related inquiry-based learning. The intention of the poster is to raise the discussion about how learning analytics from the project can be used to support and enhance learning for tangible technologies. These activities include physical computing and other lab work for small group work in higher education and high school settings.

**Keywords:** Learning Analytics, Practice-based Learning, Design, Physical Computing

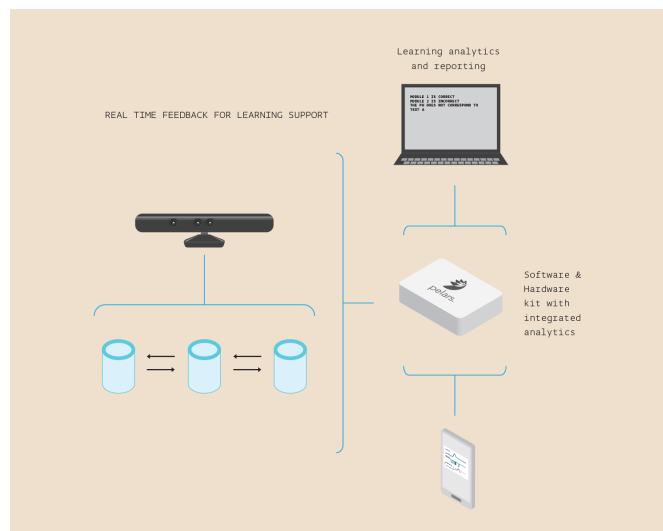
## Introduction

Educators, researchers, business leaders, and politicians are working to redesign schools to teach 21<sup>st</sup> Century skills that include: creativity, innovation, critical thinking, problem solving, communication, and collaboration (Lai & Viering, 2012). Blikstein and others (2013) offer strong arguments for how hands-on activities like digital fabrication could be a new and major process for bringing powerful ideas, literacies, and expressive tools to learners. The current challenges for designing and evaluating CSCL activities in digital fabrication scenarios are: the open-ended nature of the projects, the small group work, and the use of physical computing components that require construction and programming. This poster presents on-going work in the Practice-based Experiential Learning Analytics Research And Support (PELARS) project that aims to generate, analyze, use and provide feedback for analytics derived from hands-on, project-based learning activities. The focus of these activities are on learning and making things with physical computing activities that provide learners with opportunities to build and experiment with tangible technologies and digital fabrication. The project addresses three different learning contexts (university interaction design, engineering courses, and high school science) across four settings in Europe.

The overall research aim of the project can be summarized as: *How can physical learning environments and the hands on digital fabrication technologies in laboratories and workshops be designed to support ambient and active data collection for analytics?* The goals of the project are first; define learning (skills, knowledge, competencies) that is developing, and how we can assess it in the frame of learning analytics. Then to determine what elements of this learning we can capture by designing the physical environment and activities around digital fabrication technologies. Then to identify what patterns of data we collect can tell us about learning, collaboration and how the system can help support. Our aim is accomplish this by the development of technological tools and ICT-based methods for collecting activity data (moving image-based and embedded sensing) for learning analytics (data-mining and reasoning) of practice-based and experiential activities. This data is used to create analytics support tools for learners and teachers providing novel frameworks. These new tools can be further developed along the ideas of knowledge-communities and inquiry (Slotta, Tissenbaum, & Lui, 2013) and provide conceptualizing, representing, and analyzing distributed interaction (Suthers, Dwyer, Medina, & Vatrappu, 2010).

The current work in the project raises important questions for the CSCL community across the design of the learning environments, the technological system, and the design of the educational activities. Figure 1 illustrates an example workbench technology scenario for the project, highlighting potential elements of system implementations. The methodological approach starts with the temporal data collection, vision system data, table sensors, programming log files, and closed surveys (quantitative instruments) will be used to measure the

relationships between team collaboration, object manipulation and construction, and programming code, system usability, and artefact generation (independent variables) and the computer vision and gesture recognition for learning, activity recognition system and workflow reconstruction, learning traces, data mining for analytics, and visualisation (dependent variables). At the same time, investigating the learners' understanding of knowledge and practice in STEM activities in the workshop and the lab (central phenomenon) will be explored using participatory design, qualitative interviews, surveys observations, and design critiques. The reason for combining both qualitative and quantitative data is to understand the different research problems better by converging both quantitative (broad numeric trends) and qualitative (detailed views) data.



**Figure 1.** PELARS Learning Analytics System

One implication of the poster is to explore how the PELARS learning analytic system can be used to investigate face-to-face collaboration by capturing traces from the system while supporting open ended and hands-on learning in lab settings. Maldonado and colleagues (2013) argue that the potential of these systems is that they can be used to support learners and teachers by exploiting captured traces of interaction. Additionally, the data can provide insights by making the collaboration visible and highlighting potential problems. Secondly, the emergence of low-cost high resolution, multimodal sensors that capture diverse data opens new opportunities for supporting learning community and these technologies needs to be framed correctly in order to benefit research and practice (Worsley, 2014).

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<http://www.pelars-project.eu/>