Beyond Traditional Metrics: Using Automated Log Coding to Understand 21st Century Learning Online

Denise C. Nacu, Caitlin K. Martin, Michael Schutzenhofer, and Nichole Pinkard
Digital Youth Network & DePaul University College of Computing and Digital Media Chicago, Illinois, USA

DePaul University
digital youth network

Introduction

Log analysis in massively open online courses (MOOCs) and other online learning environments has mostly focused on metrics aligned with traditional, lecture-based instructional models such as reporting findings related to course completion rates, viewing of course content, and grades received (e.g., Ho et al., 2014, Perna et al., 2013).

Less traditional outcomes have been documented in informal K12 programs and in online communities that are critical to the 21st century skill-set, including managing information; directing learning pathways; collaborating on projects; discussion and critique around common artifacts; and building collective intelligence (Barron et al., 2014; Ito et al., 2013).

Given the attention to these types of outcomes and the capabilities of online systems, there have been recent calls for the conceptualization of new analytics that are more relevant to social learning models that emphasize personalization, collaboration on projects, and learning as a process of identity development as opposed to only accumulating content knowledge (e.g. Eisenberg & Fischer, 2014; Pea, 2013).

We describe our method of log coding in the data-preprocessing phase. This type of framework is needed to reveal patterns of 21st century learning in systems such as MOOCs as well as smaller scale online learning environments.

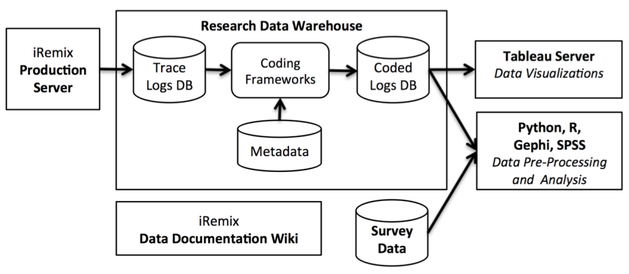


Figure 1. Technical configuration of iRemix enabling automated log coding

Coding Framework

Our coding framework highlights both student and educator actions to describe learning activity online. We build on previous work that has defined capacities and dispositions critical for learners in the 21st century (Barron et al., 2014), as well as studies of youth adult interactions and roles played to support the development of such dispositions (Nacu, et al., 2014; Barron et al., 2014), and analysis of common features of online social learning networks.

In this work, the types of 21st century learning activities we focus on reflect three primary goals of the focal learning environment (Digital Youth Network programming and platform, Barron et al., 2014).

Focal 21st Century Learning Themes
Creative production. Understanding and using appropriate media, elaborating and refining ideas and work, creating new and worthwhile ideas, developing media literacy and technological fluency and confidence through production and participation.
Self-directed learning. Reflecting on learning experiences and processes, personalizing learning by making connections with individual interests and goals, taking initiative and making decisions, developing self-direction, seeking out information.
Social learning. Communicating and collaborating around work and ideas, being open to new ideas and perspectives, teaching and learning from others.

Table 1. 21st century learning activities afforded in online social learning networks.

Table 2. Educator online learning support roles.

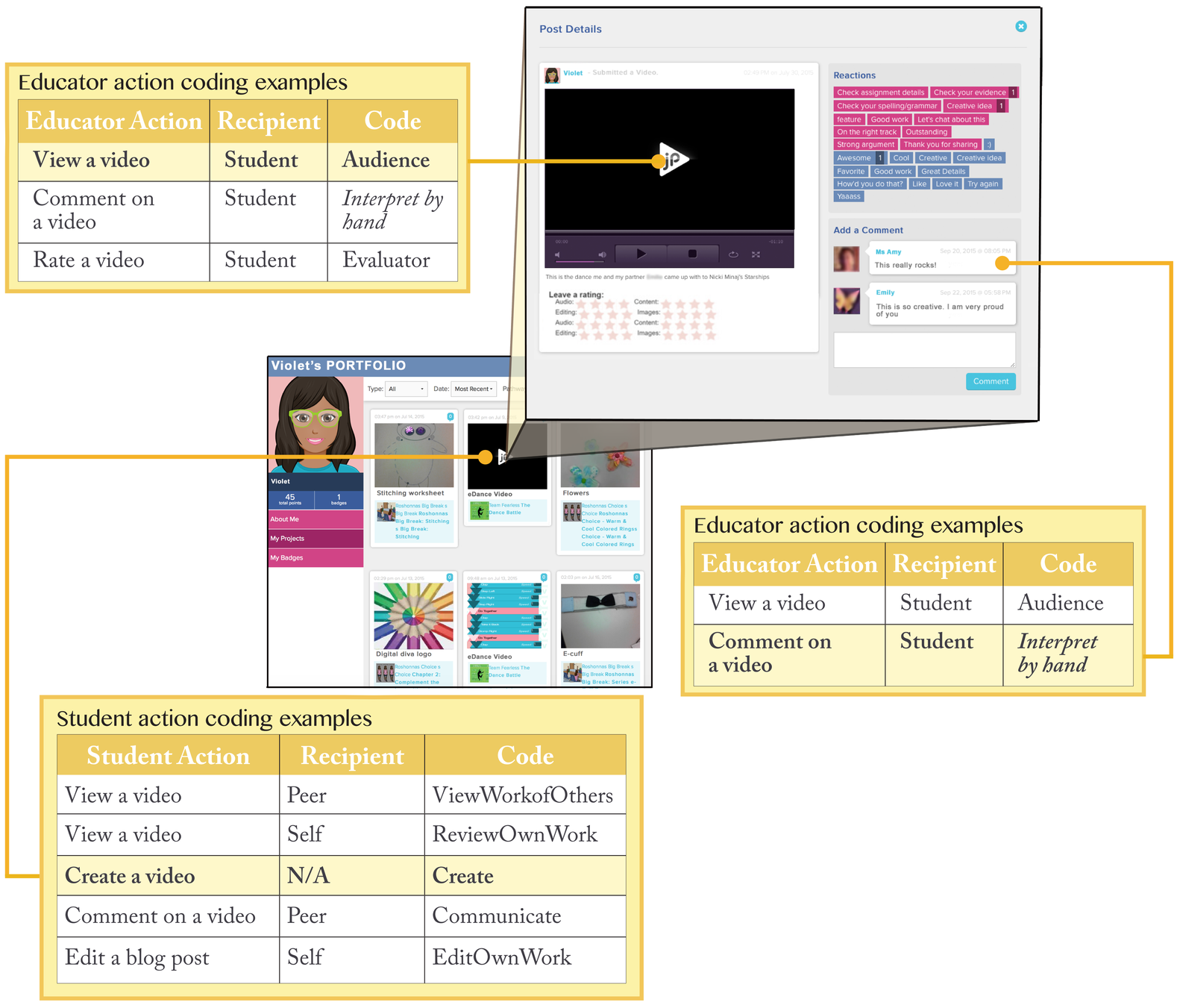
Educator Online Learning Support Roles	
Audience	View what youth are doing online
Encourager	Encourage youth about work or participation
Evaluator	Provide grades, ratings, badges, or other formal assessments
Friend	Exhibit personal approachability, friendship, or mentorship including social posts, off-topic conversation
Instructor	Directly teach a concept or skill or provide an assignment. Provide prompts and/or feedback to further student thinking or work
Learning Broker	Connect youth with learning opportunities (e.g., people, activities, institutions, etc.)
Model	Share own creative work/process
Monitor	Impose or suggest rules of behavior online
Promoter	Showcase youth participant work
Resource Provider	Provide learning resources (how-to guides, links, embedded media, etc.)

Table 3. A sample of student action codes as aligned to 21st century skills.

Student Action Codes and 21st Century Skills		
View Resources	Work independently using posted resources	Self-directed learning
Review own work	Reflection on work and progress	Self-directed learning
Create	Making and posting creative work	Creative production
Communicate	Commenting on work, sending messages, participating in debates	Social learning
Edit work	Review work, incorporate feedback, cycles of work	Creative production
Develop identity	Creating and editing user profiles	Creative production
Observe and connect	Viewing and participating in groups	Social learning
Exploration	Looking at potential activities	Self-directed learning

Coding Examples

To prepare a target dataset for data mining and pattern analysis, we process a database of Actions from the iRemix platform. Based on variables in the Action logs that indicate who performed what type of action to whom (if applicable), we derive *Actor*, *Action*, and *Recipient*. Together, data from these variables define a unique type of log to which we apply an interpretive code based on analysis of either Student actions or Educator actions. Thus, a set of coding rules use *Actor*, *Action*, and *Recipient* data to automatically generate the target dataset.



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