The journey is the destination: Process-oriented data visualisations to explore appropriation in open-ended robotics

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RATIONALE

Open-ended project-based learning activites are rooted in constructivist, student-centred, growth-based pedagogies which emphasise a trial and error learning process over perfect end results. (Cukurova, Avramides, Spikol, Luckin, & Mavrikis, 2016; Berland, Baker, & Blikstein, 2014; Papert, 1993). In addition, open-ended projects offer students the chance to externalise their own interpretation of the ideas they are exposed to, associate them with previously existing concepts and in that process, expand their corpus of personal understanding (Duckworth, Yeager, 2015; Polman, 2006). The open-ended aspect of project-based learning is explored in the educational theory literature via the concept of **appropriation**, as the self-constructive component of activity (Poizat, Haradji, & Ade, 2013; Wertsch, 1991). However current project-based learning assessments are usually based on the resulting end-product of the project, such as an artefact or a portfolio, overlooking the actual cognitive and development processes that occur **in the process** (Black & Wiliam, 2010; Resnick et al., 1998), such as appropriation.

Berland, M., Baker, R., & Blikstein, P. (2014, 07). Educational data mining and learning analytics: Applications to constructionist research. Technology, Knowledge and Learning, 19. doi: 10.1007/s10758-014-9223-7

AIMS

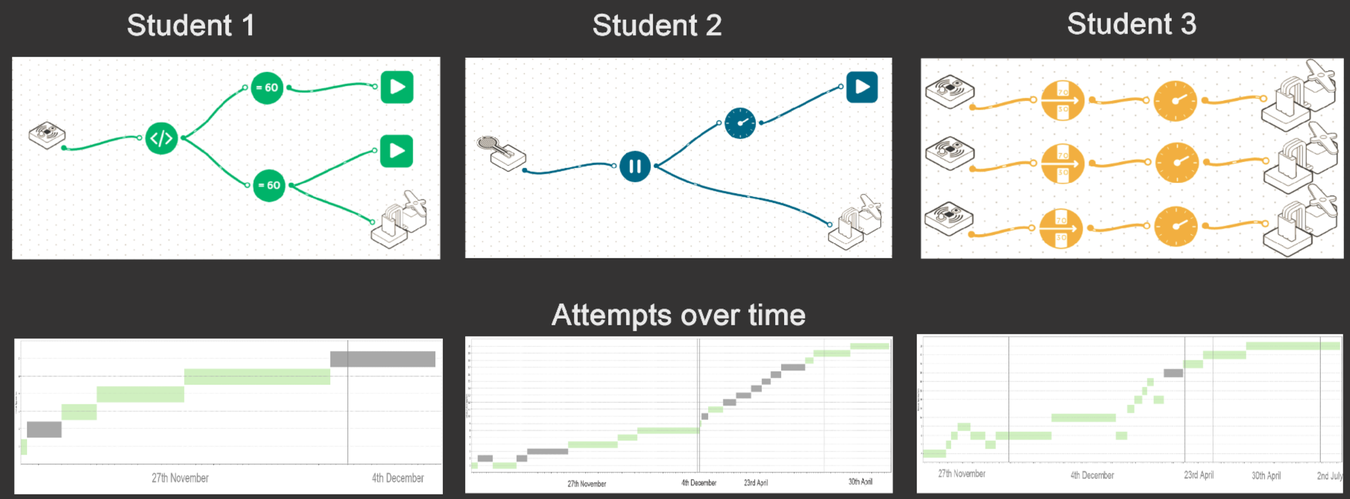
The study uses **trace log data** which stores every **version** of the students' work to produce **visualisations** which showcase the **experimentation process**, during the project timeline, **independent of final outcomes**. Drawing upon quantitative ethnography (Shaffer,2017) and the theory of appropriation (Rogoff, 2005; Wertsch, 1991), the trace logs data was structured across three dimensions of **variety, validity and complexity** to characterise the students' actions (Fry, 2007). **Aspects of students' appropriation** of the SAM Labs kits are discussed as they emerge from comparisons between students' experimentation process.

Black, P., & Wiliam, D. (2010, 09). Inside the black box raising standards through classroom assessment. http://lst-iiep.iiep-unesco.org/cgi-bin/wwwi32.exe/[in=epidoc1.in]/?t2000=022921/(100), 80. doi: 10.1177/003172171009200119

Cukurova, M., Avramides, K., Spikol, D., Luckin, R., & Mavrikis, M. (2016, 02). An analysis framework for collaborative problem solving in practice-based learning activities: A mixed-method approach. 84-88. doi: 10.1145/2883851.2883900

Duckworth, A., & Yeager, D. (2015, 05). Measurement matters: Assessing personal qualities other than cognitive ability for educational purposes. Educational Researcher, 44, 237-251. doi: 10.3102/0013189X15584327

Fry, B. (2007). Visualizing data. O'Reilly Media.



METHOD

The data was collected at a London school, during a real-life Design and Technology project spanning over six months, with 18 children aged 10-12. The children built **intelligent board games**, inspired by traditional games but enhanced with **electronic behaviours** build using the SAM Labs blocks, such as automatic dice, trap doors, light and sound effects as the players progress on the board. Each version of the virtual circuits was logged to record the **modifications** students make to their artefacts. These provide a versioning of the graphs throughout the project timeline. Each log record contains:

- The blocks which make up the virtual graph
- The connections between blocks
- The timestamp of the version

Papert, S. (1993). The children's machine: Rethinking school in the age of the computer. New York, USA: Basic Books, Inc.

Poizat, G., Haradji, Y., & Adé , D. (2013, 02). When design of everyday things meets lifelong learning....International Journal of Lifelong Education, 32. doi: 10.1080/02601370.2012.734485

Polman, J. (2006, 04). Mastery and appropriation as means to understand the interplay of history learning and identity trajectories. Journal of The Learning Sciences - J LEARN SCI, 15, 221-259. doi: 10.1207/s15327809jls1502 3

Resnick, M., Martin, F., Berg, R., Borovoy, R., Colella, V., Kramer, K., & Silverman, B. (1998, 01). Digital manipulatives: New toys to think with. , 281-287.

Rogoff, B. (1995). Observing sociocultual activity on three planes: Participatory appropriation, guided participation, and apprenticeship. In J. V. Wertsch, P. del Rio, and A. Alvarez (Eds.), Sociocultural studies of mind. New York: Cambridge University Press., 139–164.

Shaffer, D. (2017). Quantitative ethnography. Cathcart Press.

Wertsch, J. V. (1991). Voices of the mind: A sociocultural approach to mediated action. Harvard University Press. Cambridge.

EMERGING RESULTS

From the visualisations, appropriation comes through in various forms:

- the different blocks used to achieve the same goal
- the different experiments of achieving the same goal
- the different contexts of using the same block
- the different experimentation volume
- the different final implementations

3 **emerging themes** from initial explorations with teachers:

1) showing the construction journey in full has value in understanding individual students' nuances

2) cross-contextual applications of the same functionality can differ significantly

3) emerging tensions between complexity, variety and validity as students experiment