Context and Collaborative Problem Solving (CPS): The Development of Observable Signifiers to Inform the Design of CPS Learning Analytics

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Abstract: Collaborative Problem Solving (CPS) is a key skill for the modern workplace. We do not, however, have widely accepted ways of assessing and monitoring CPS to inform educators and learners and enable the provision of effective support. This paper reports the findings of an empirical study involving 15 school students aged 14-15 years taking part in a 2-day Hack Event. The analysis identifies the observable signifiers of CPS and offers a step towards the design of automated data capture protocols and CPS learning analytics.

Introduction

Collaborative Problem Solving (CPS) is a term that is increasingly used to refer to *the process of a number of persons working together as equals to solve a problem* (Luckin et al., in press). It brings together thinking and research about the separate topics of 'collaboration' and 'problem-solving', both of which have a substantial research history in their own right. The changing needs of the workplace, the recognition of the increasing importance of what are often referred to as 21st-century skills, and the continuing development of international comparison studies, such as the OECD PISA evaluations, have prompted intensified interest in CPS (OECD, 2015). We do not, however, have widely accepted ways of assessing and monitoring CPS to inform educators and learners and enable the provision of effective support. The PELARS project is exploring the design of learning analytics to support CPS in project-based learning settings. As part of this research, it is essential to identify the observable signifiers of effective CPS and to specify if and how the capture and analysis of these signifiers can be automated. Our driving research question is: *How can we assess the effectiveness of a particular instance of CPS to inform the future design of learning analytics and software scaffolding?*

Methodology

We use the Ecology of Resources (EoR) model and a framework to analyse data from group interactions to identify CPS processes (Luckin, 2010), complemented with the work of Chi et al. (2012) to categorise the processes of CPS identified through the EoR-Chi framework. The analysis framework, which we used to code the interaction data collected in the study we report here is illustrated in Table 1.

Table 1: The EoR-Chi Framework for Analysis

Code	Code Name	Definition
0	Non-available	The resource exists within the learner's context but is not in the learner's service.
1	Available	The resource is in the context of the learner, yet the learner is not engaged with it.
2	Passive	The resource is in the context and the learner pays attention to it.
3	Active	Learner pays attention to the resource and physically interacts with the resource.
4	Constructive	Learner pays attention to and physically interacts with resource, generates knowledge for self.
5	Interactive	Learner pays attention to and physically interacts with a resource, generates knowledge for self and helps others generate knowledge.

The empirical study: The Education Hack 2015

15 students aged 14-15 years, none of whom had previous experience with the study technology or activity. Over 10 hours of video was coded by two researchers according to the EoR framework and the EoR-Chi framework. The coding was completed from the perspective of each individual learner. Resource use was recorded at 30-second intervals. The two researchers discussed all disagreements and reached a consensus.

Results

Figure 1 presents a comparison of the total resources used by all groups of learners over the same 1-hour period of the hack event. It clearly illustrates the differences between the groups. For example, the group developing

the glove prototype made greater use of the adult resources available and of the technology. They also interacted with the prototype. By comparison, the coin sorter group used each other and made heavy use of paper and instructions. They used the prototype components but had no prototype to interact with at this time.

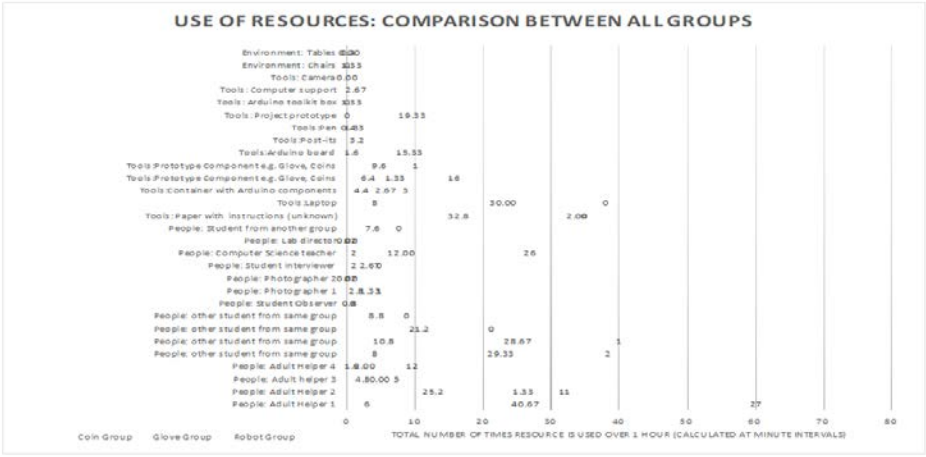
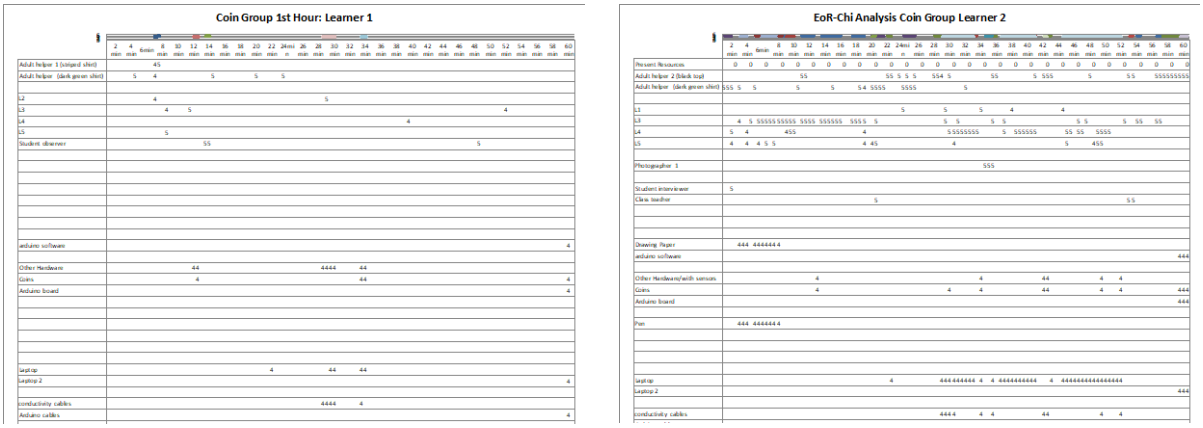


Figure 1. Comparison of resource use by groups of students.

The EoR-Chi analysis for L1 and L2 as illustrated in Figure 2a reveals that there is only 12 minutes, which is less than 20% of the hour-long session in which L1 interacts at EoR-Chi levels 4 or 5. This suggests that L1 engages in limited higher order interactions in this particular hour long session of the Hack Event. By contrast, L2, as illustrated in Figure 2b, interacts at EoR-Chi levels 4 or 5 for 53 minutes (89%) of the session.



Figures 2a (L1) and 2b (L2). The EoR-Chi levels 4 and 5 analysis for L1 and L2 from the Coin group.

Our results using the EoR-Chi framework show that both individual students and groups of students present different patterns of engagement with the human and tool resources around them during practice-based learning activities. We argue that these differences between the groups and individual students' use of resources may indicate their different degree of engagement with the CPS process.

References

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