Designing awareness tools for teachers in exploratory learning settings

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Research Motivation

Advantages of Exploratory Learning environments for students' engagement and "deep" learning e.g.

- microworlds
- virtual science labs
- educational games
- physical computing kits

Role of the teacher in an Exploratory Learning setting is that of facilitator/orchestrator/coach

Research Motivation

Obstacles to teachers' use of ELEs include:

- the need to provide support to students (through the ELE and by the teacher) so as to ensure productive interaction with the learning environment and achievement of learning goals

- the need to overcome teachers' perceived lack of 'control' over their students' learning activities when ELEs are being used
- our approach: provide *Teacher Assistance tools* to enhance teachers' awareness of students' engagement and progress with the task set

Challenges of providing support

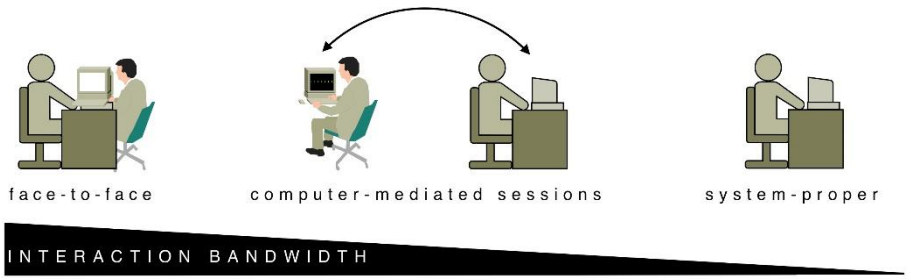
- generally not a direct link between students' interactions in the ELE and the knowledge domain
- tasks are open-ended and there is not a single 'correct' answer
- balance is needed between students' freedom to explore and guidance towards achieving learning goals
- teachers are less familiar with tools that facilitate exploratory learning; so harder to elicit their requirements regarding the support that Teacher Assistance tools should provide for them

Our approach

- Design intelligent components, integrated into the ELE, that provide personalised feedback to students as they are working on the task set
- Design a suite of Teacher Assistance tools, each visualising the occurrence of a set of *key indicators* and serving a particular purpose
  - aim is to enhance the teacher's awareness of students' progress on the task set, and inform the teacher's own interventions to support students both individually and the class as a whole
  - a variety of computational intelligence techniques are used to detect indicators (case-based reasoning, rule-based reasoning, pattern-matching, sequence detection)

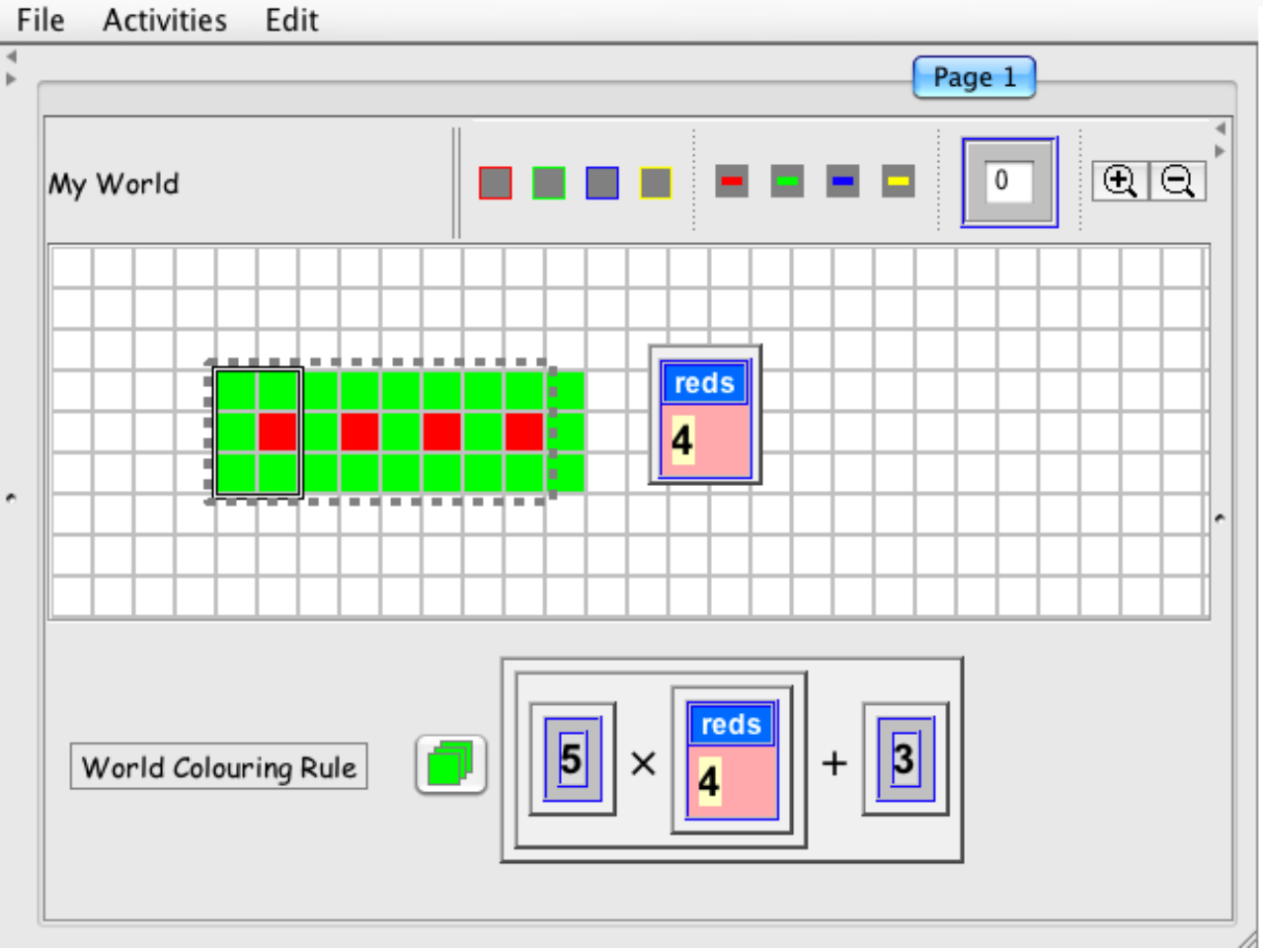
Methodology

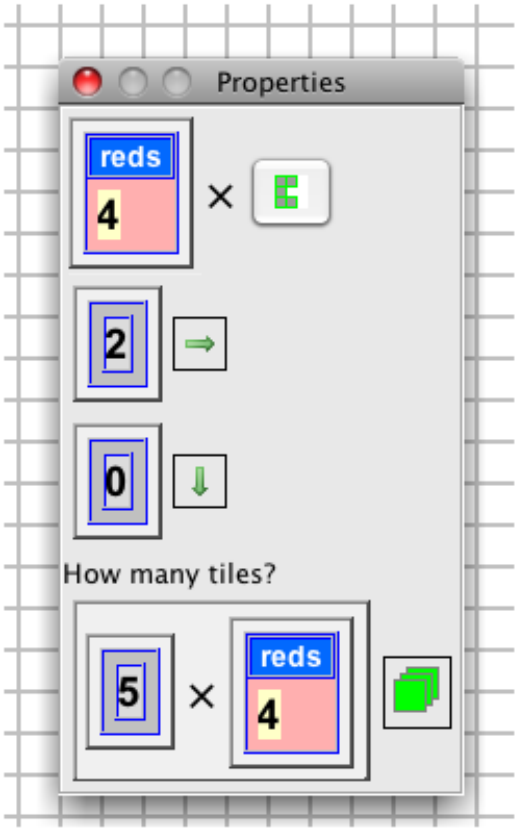
1. Design a first version of the ELE itself (if not an existing ELE)
2. Design feedback for students
   - successive prototypes of increasing functionality co-designed and trialled with groups of students and teachers



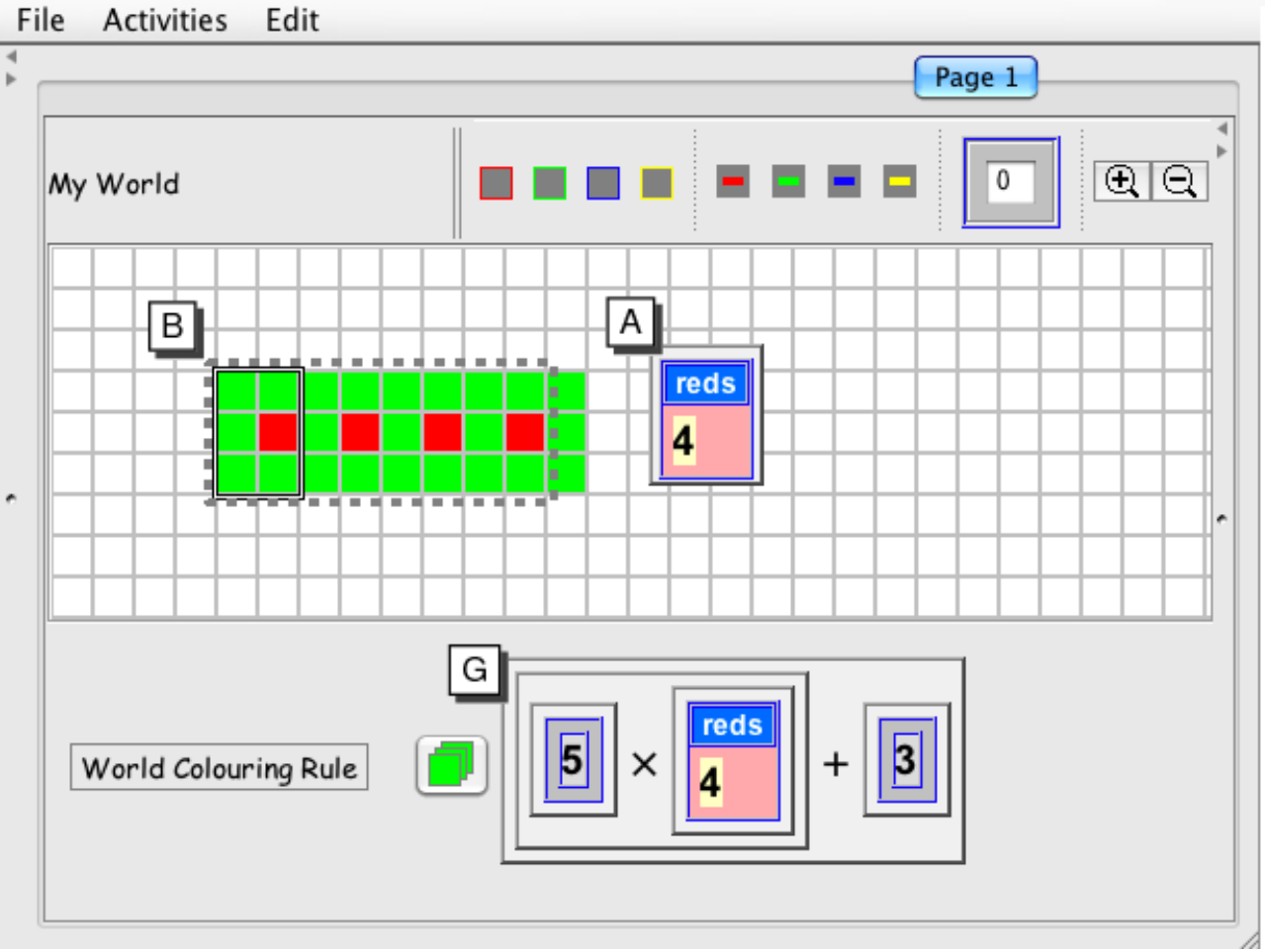
   - trials inform also refinement of the ELE itself
3. Identify indicators and design TA tools

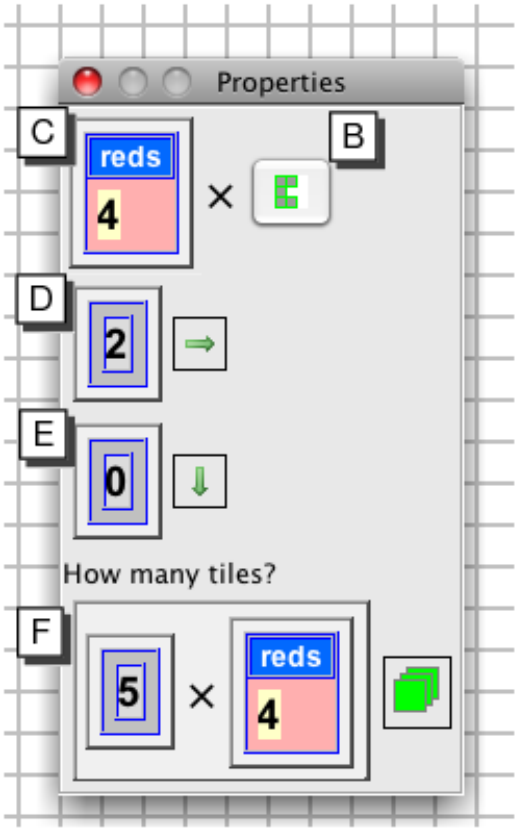
Example 1: eXpresser microworld



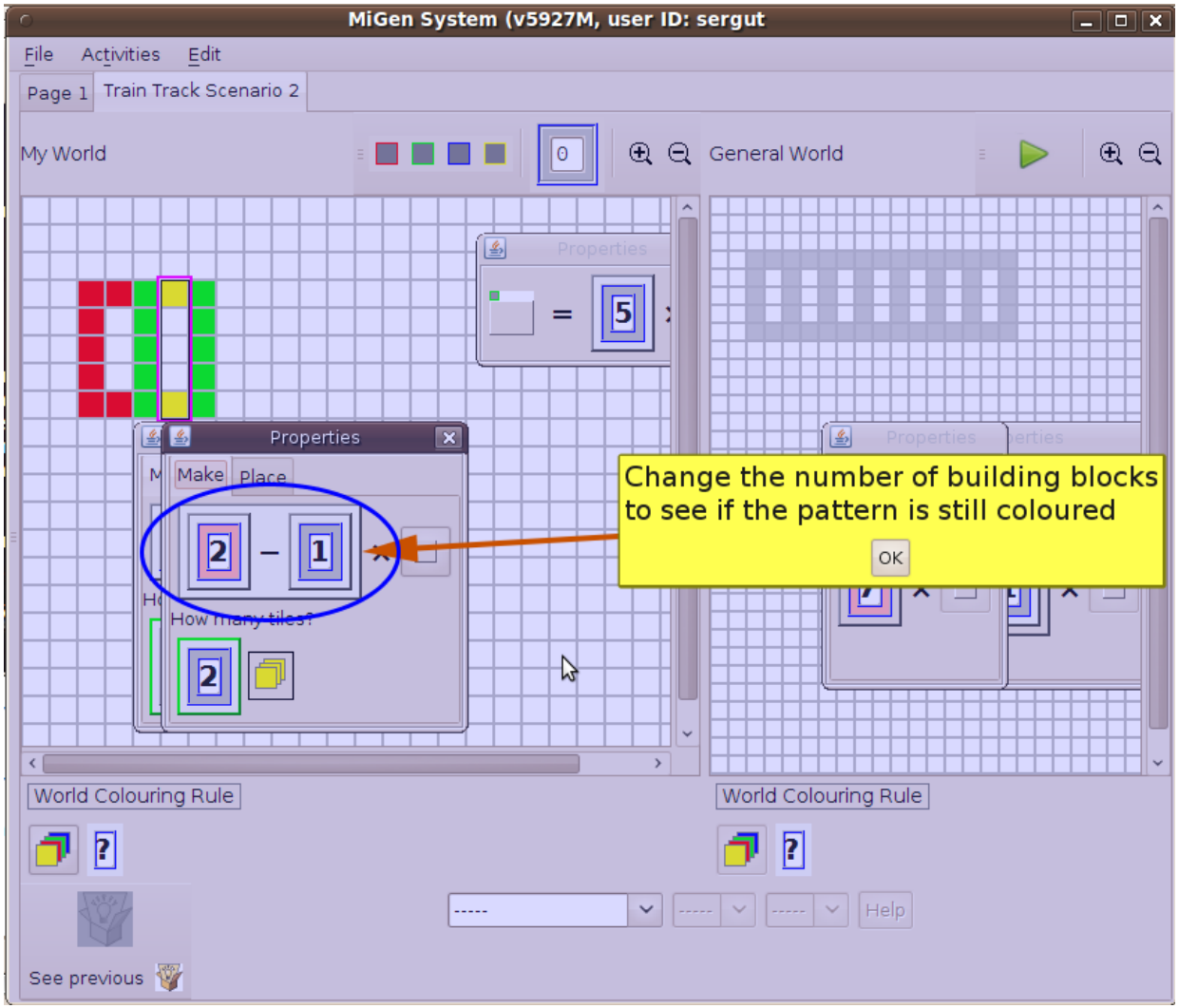


eXpresser microworld

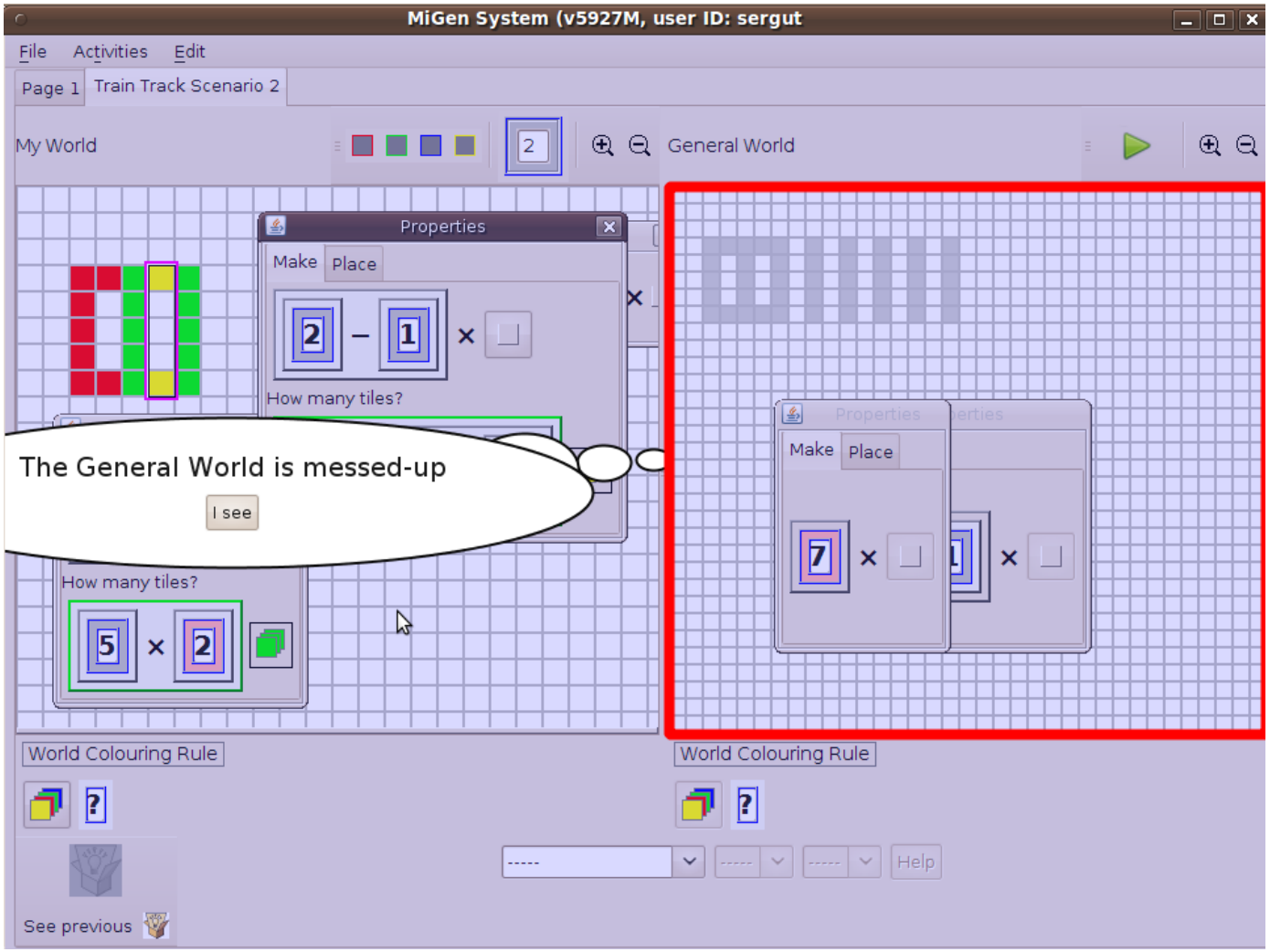




student feedback



student feedback



Methodology – teacher tools

Phase A:

- Requirements elicitation and prototyping, working with teachers in focus groups and one-to-one
- Results in a preliminary set of indicators to be detected and visualised, and early versions of tools

Phase B:

- Classroom sessions trialling the tools with teachers
- Results in refinement and extension of the tools
- Also in the identification of a full set of Usage Scenarios for the tools

Methodology – teacher tools

Phase C:

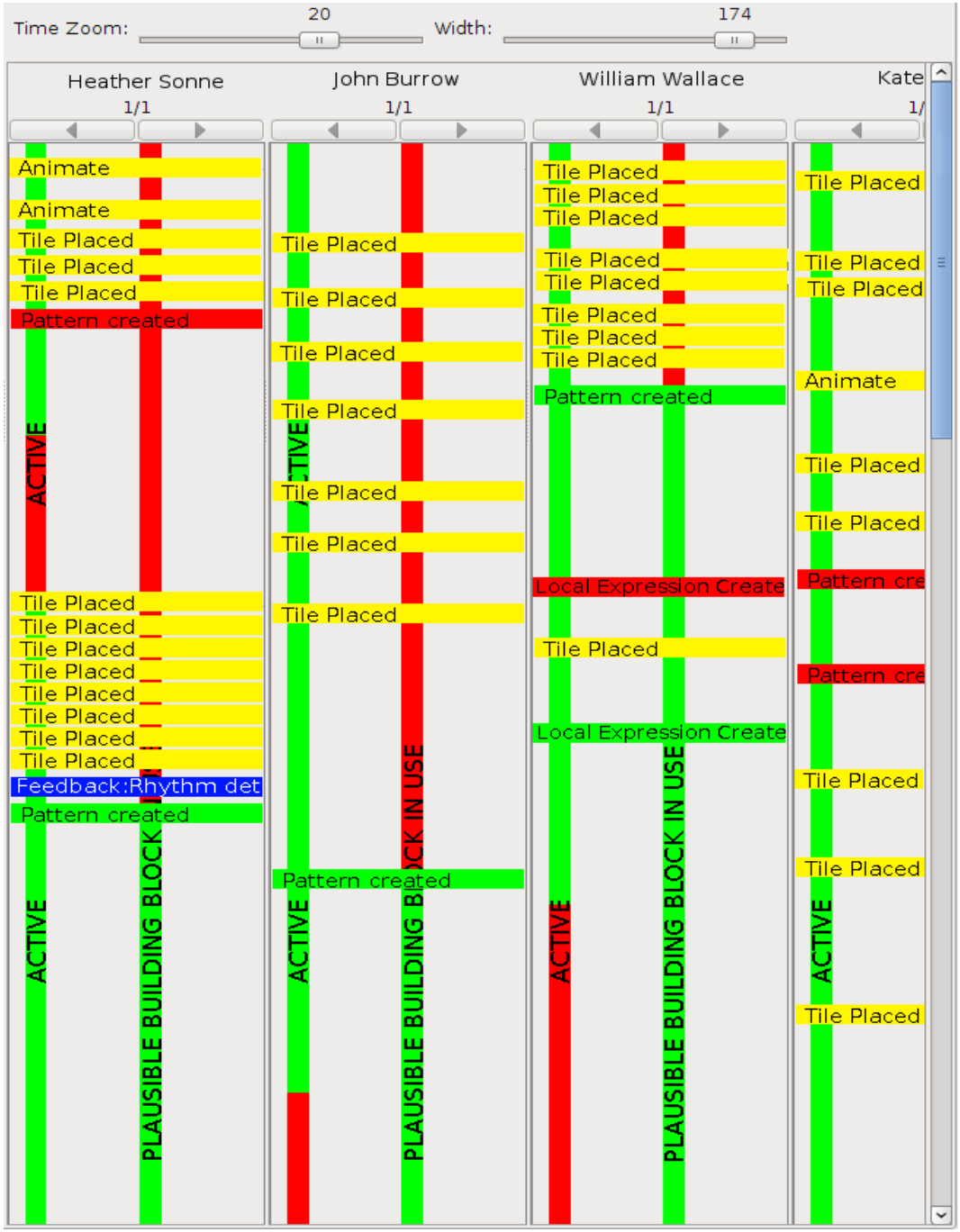
- Formative evaluation of the tools with respect to the Usage Scenarios (lab-based and classroom-based)

Phase D:

- Summative evaluation (lab-based and classroom-based)

First Teacher Tool developed

- *Student Tracking* tool shows occurrence of all indicators identified through by our teacher collaborators as being useful (Phase A):
  - green : productive interaction
  - red : unproductive interaction
  - yellow : could be either
- A default subset of most important indicators is displayed by the ST tool
- Teacher can select to turn on/turn off others


Time Zoom:
20
Width:
174
Heather Sonne
1/1
John Burrow
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William Wallace
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Kate
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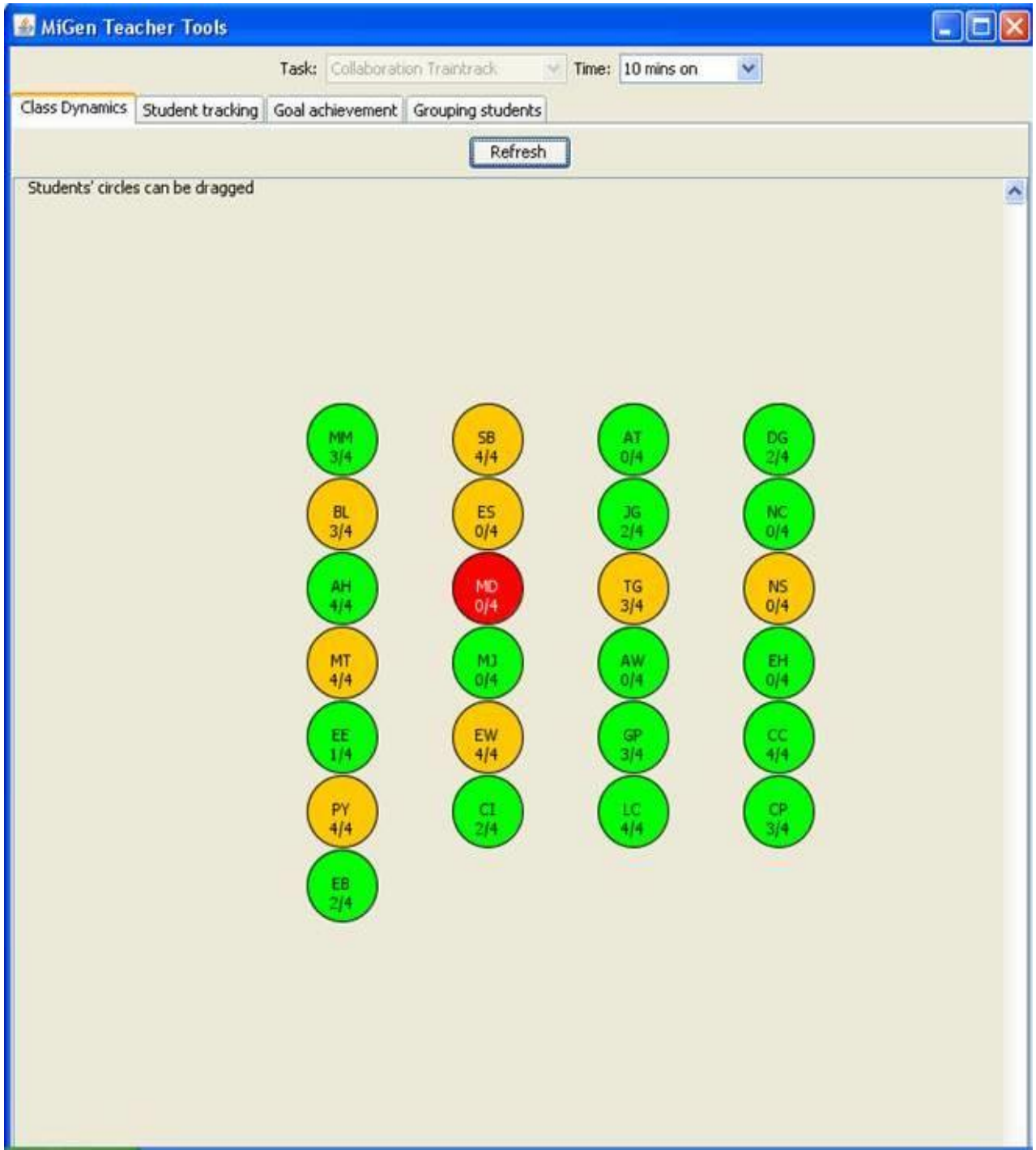
ACTIVE
PLAUSIBLE BUILDING BLOCK IN USE

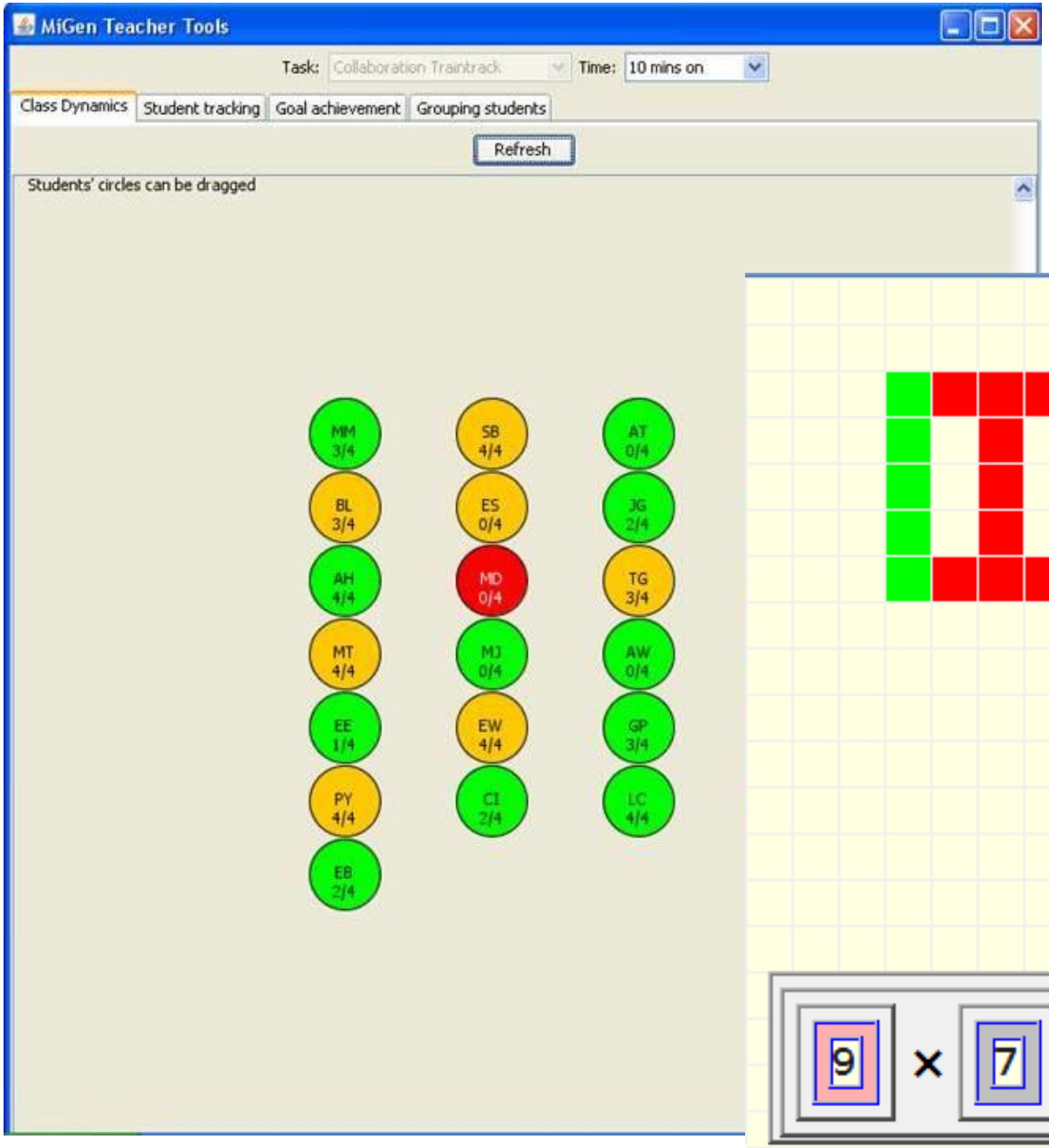
Trialling in Phase B identified contextualised usage scenarios

- Who needs my help right now?
- Who isn't working on the task set?
- How are students approaching the task?
- How are they progressing with the task goals?
- Have they finished the task?
- How should I pair students for productive discussion of their solutions?

Leading to co-design and evaluation of additional Teacher Assistance tools

- *Classroom Dynamics* tool
- *Goal Achievements* tool
- *Grouping* tool


MiGen Teacher Tools
Task:
Collaboration Traintrack
Time:
10 mins on
Class Dynamics
Student tracking
Goal achievement
Grouping students
Refresh
Students' circles can be dragged
MM 3/4
BL 3/4
AH 4/4
MT 4/4
EE 1/4
PY 4/4
EB 2/4
SB 4/4
ES 0/4
MD 0/4
MJ 0/4
EW 4/4
CI 2/4
AT 0/4
JG 2/4
TG 3/4
AW 0/4
GP 3/4
LC 4/4
DG 2/4
NC 0/4
NS 0/4
EH 0/4
CC 4/4
CP 3/4


MiGen Teacher Tools
Task:
Collaboration Traintrack
Time:
10 mins on
Class Dynamics
Student tracking
Goal achievement
Grouping students
Refresh
Students' circles can be dragged
MM 3/4
BL 3/4
AH 4/4
MT 4/4
EE 1/4
PY 4/4
EB 2/4
SB 4/4
ES 0/4
MD 0/4
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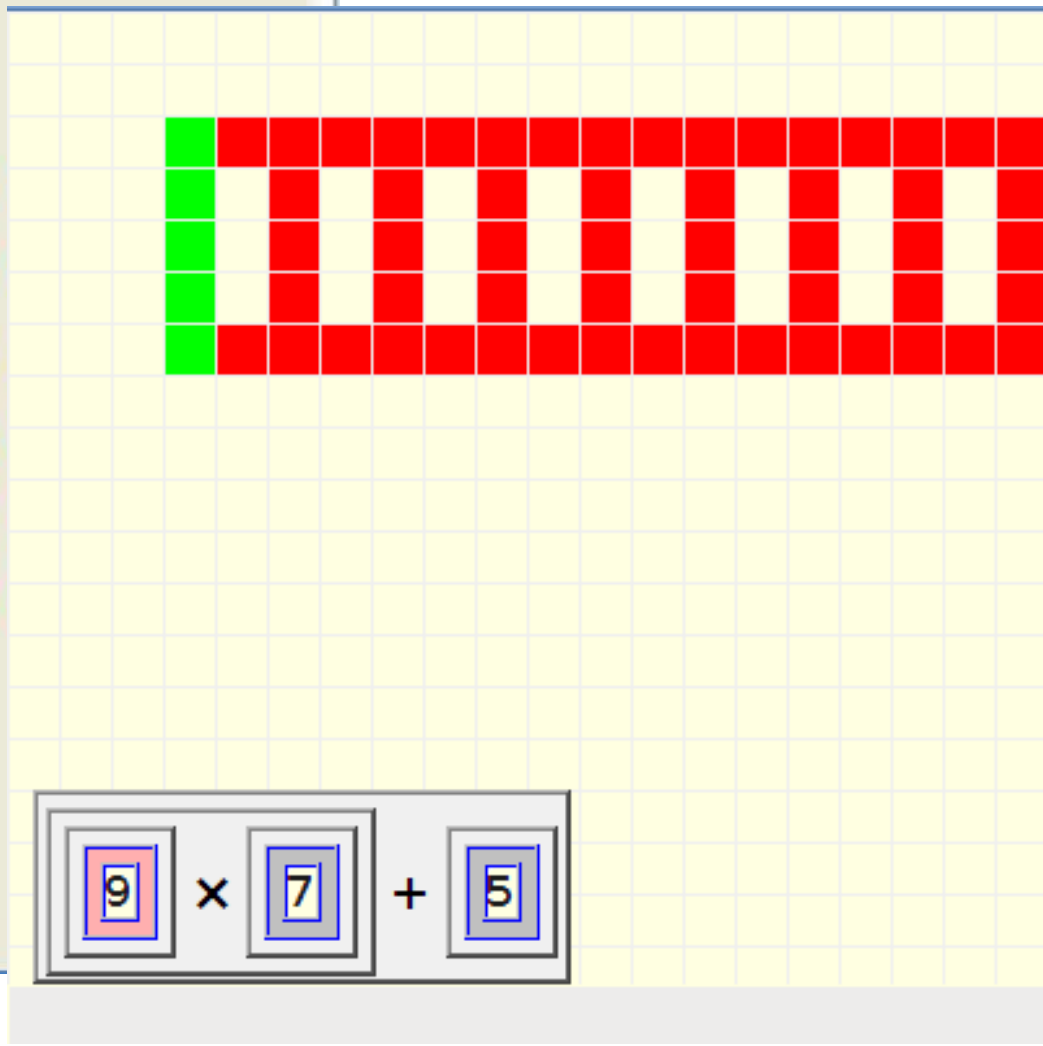
LC 4/4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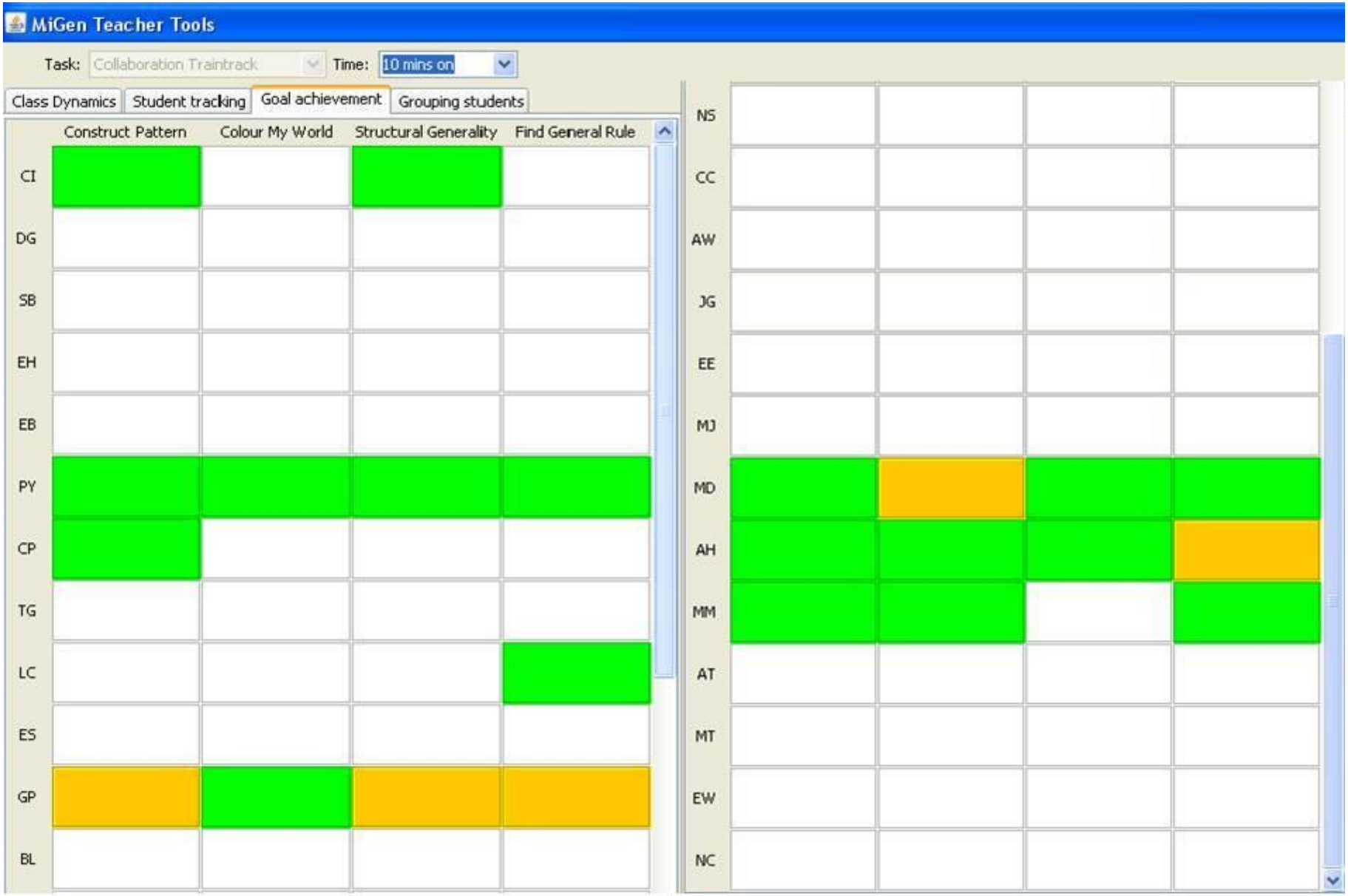
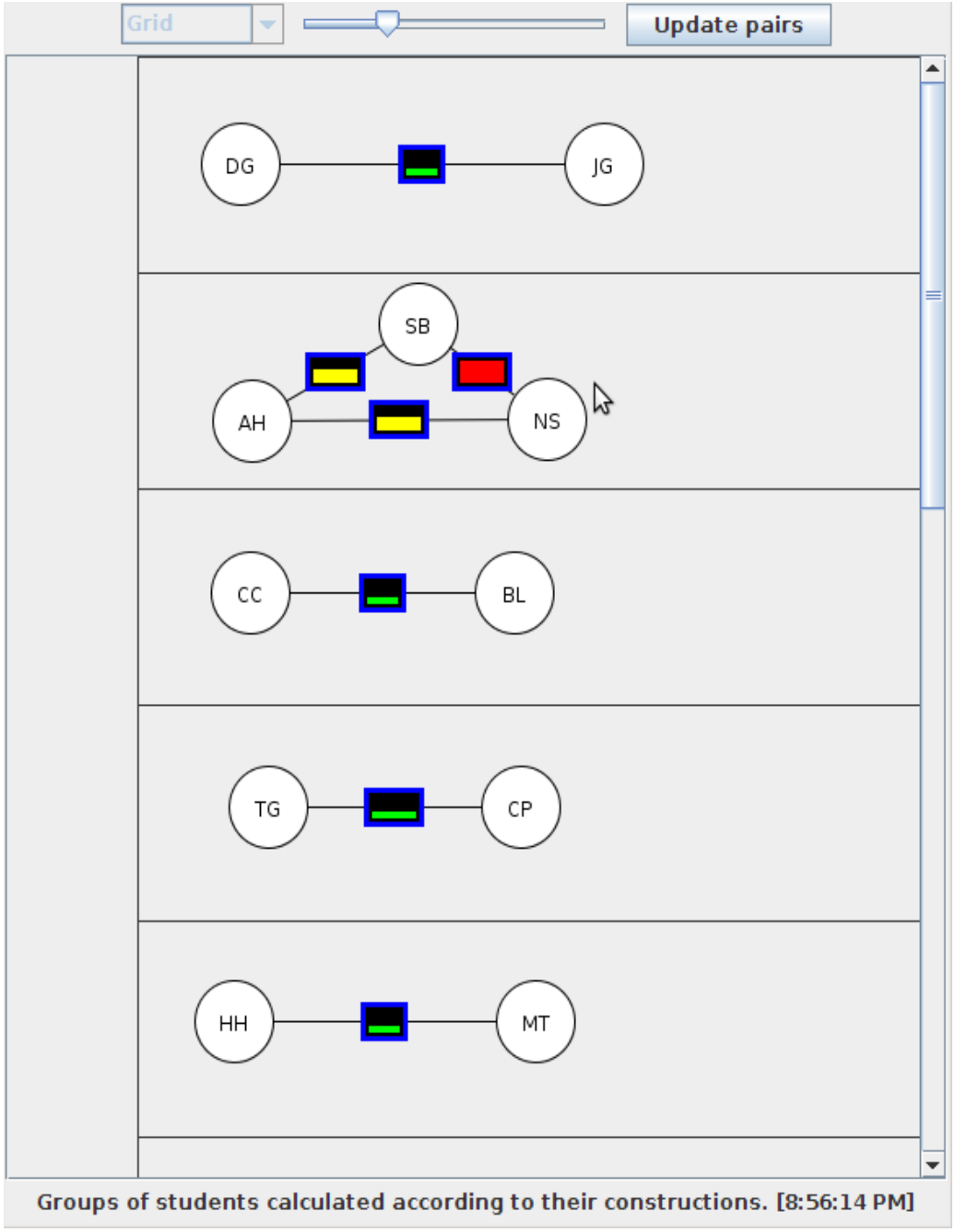
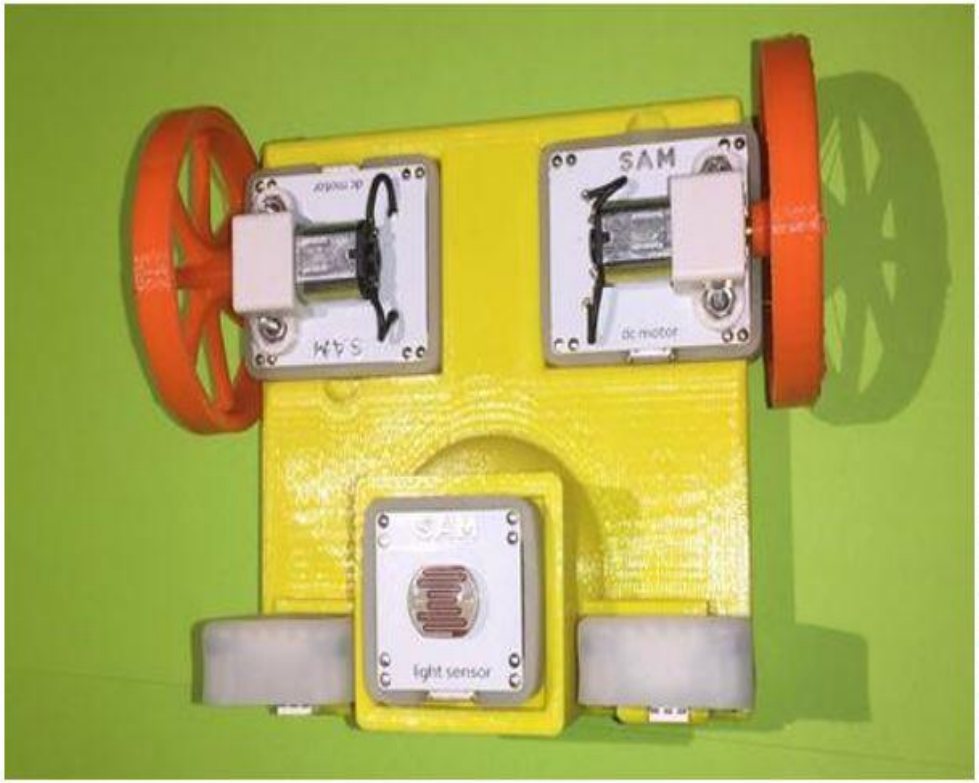
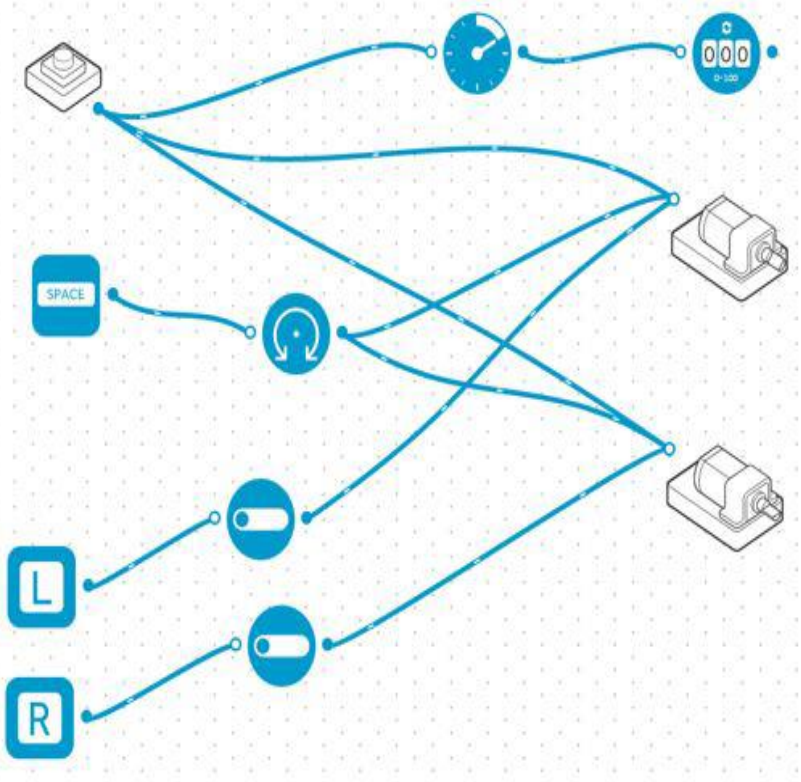

MiGen Teacher Tools
Task:
Collaboration Traintrack
Time:
10 mins on
Class Dynamics
Student tracking
Goal achievement
Grouping students
Construct Pattern
Colour My World
Structural Generality
Find General Rule
CI
DG
SB
EH
EB
PY
CP
TG
LC
ES
GP
BL
NS
CC
AW
JG
EE
MJ
MD
AH
MM
AT
MT
EW
NC


Grid
Update pairs
DG
JG
SB
AH
NS
CC
BL
TG
CP
HH
MT
Groups of students calculated according to their constructions. [8:56:14 PM]

Example 2: SAM labs

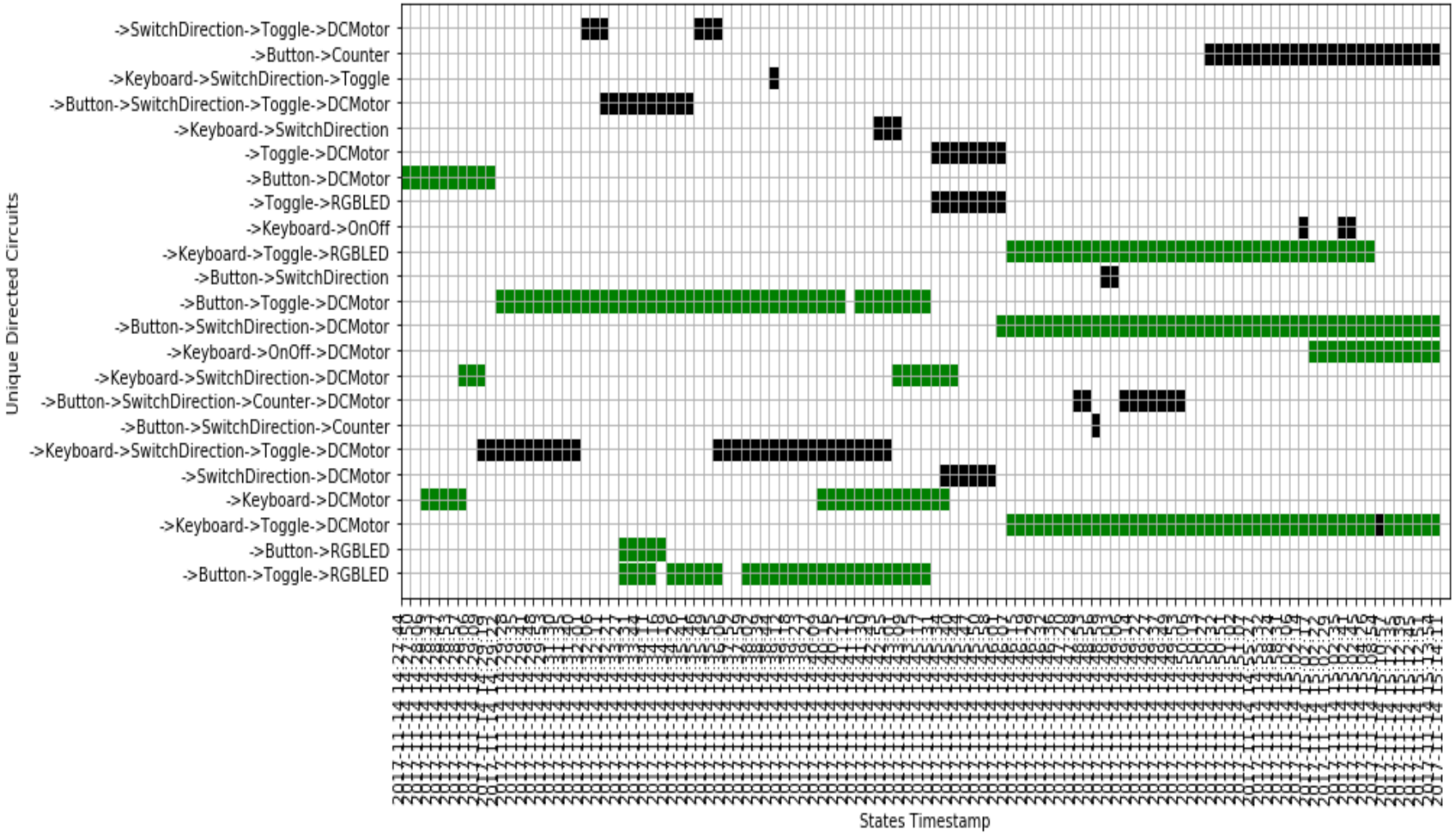




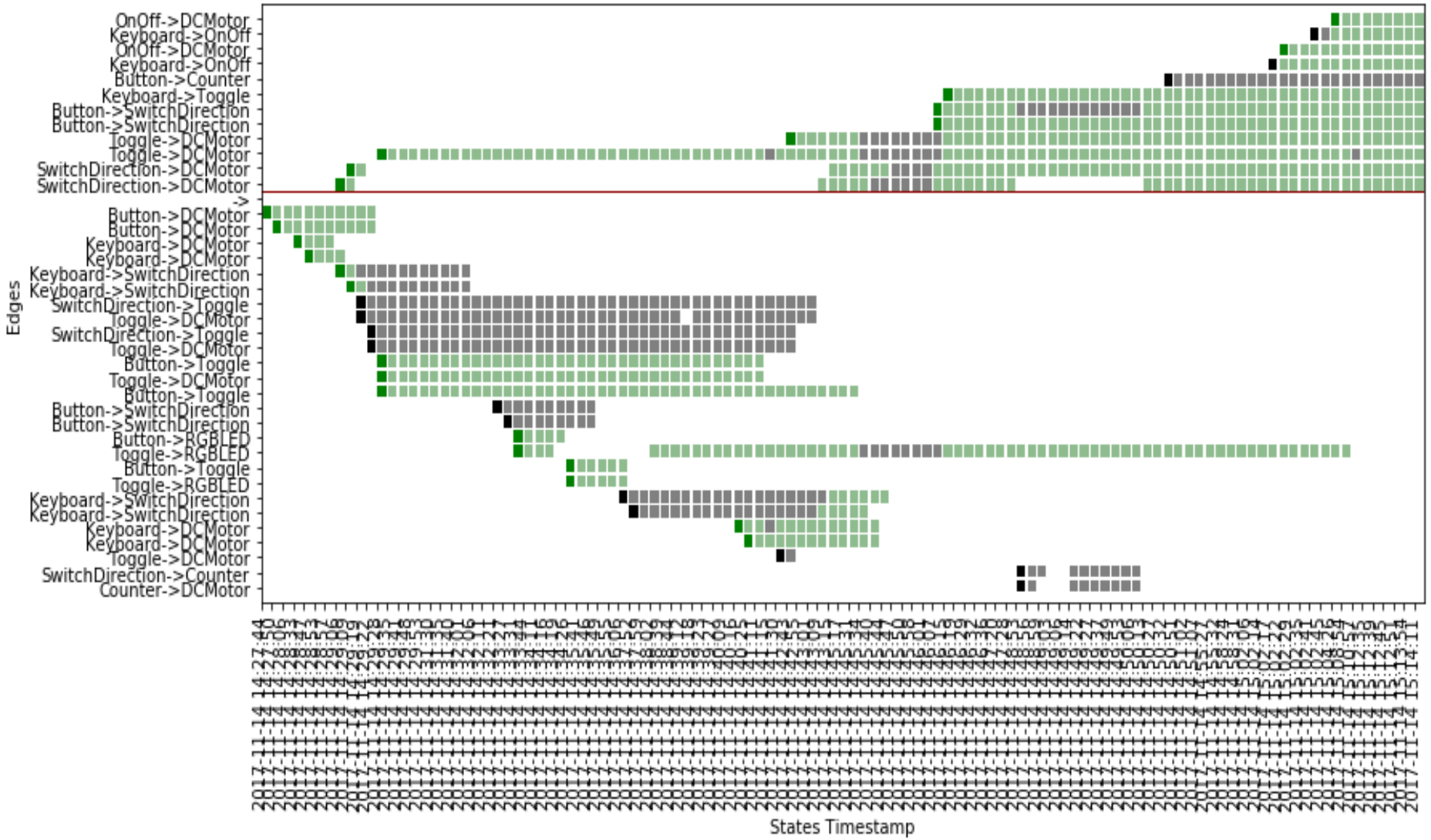
Phase A – teachers' questions

- What SAM blocks do the students use?
- What circuits do they put together with the blocks?
- How do they evolve their circuits over time?
- To what extent do they change their circuits in order to make them functionally correct?
- When looking at a specific change, what previous moves informed that change? What future moves are triggered by that change?
- …

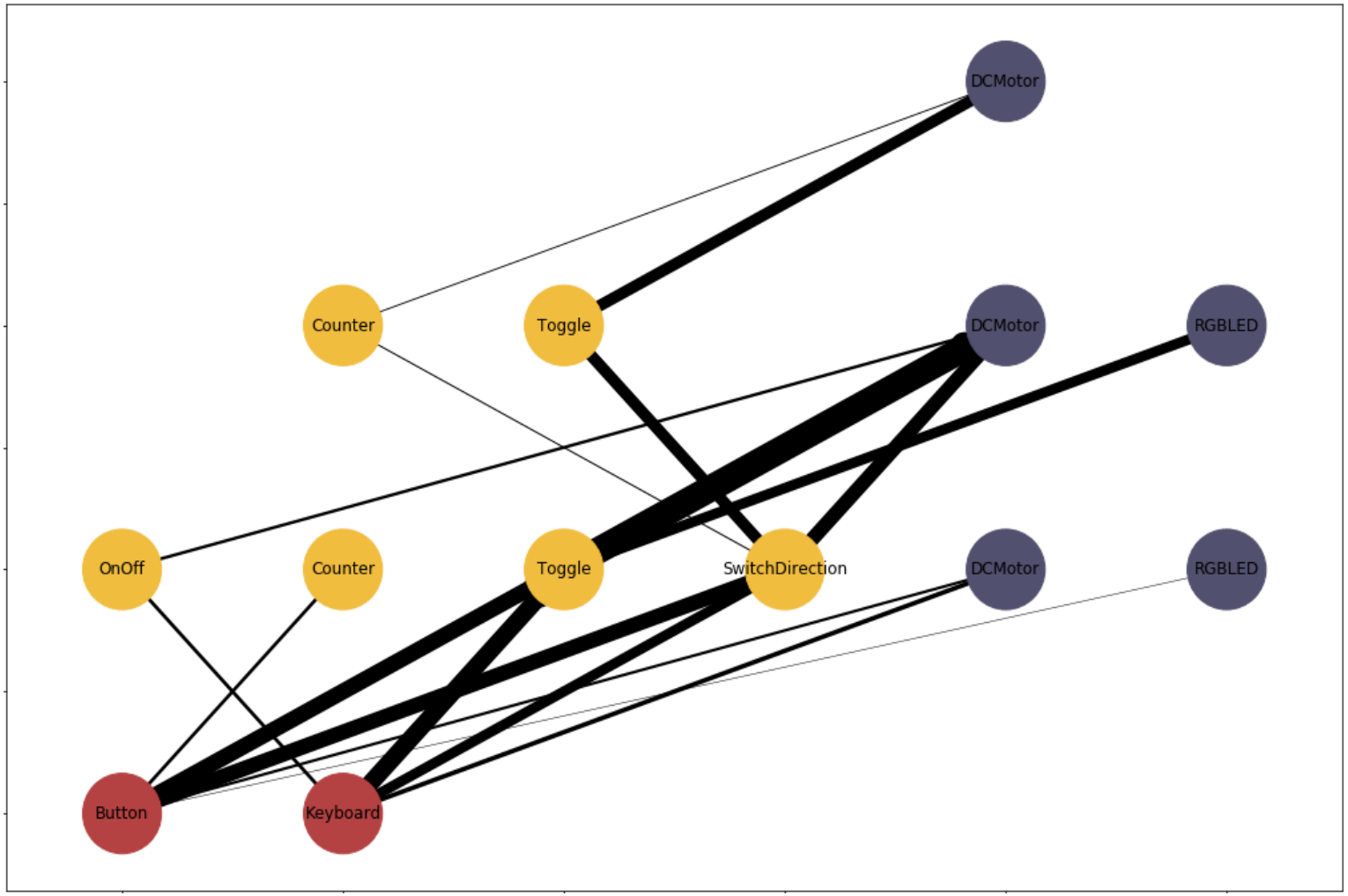
Students' progress on circuit construction



Students' creation of links



Students' link usage summary



Future work

- completion of Phases B-D for SAM Labs
- design of TA tools for other exploratory learning environments
- scaling out TA tools to online exploratory learning settings
- developing new data analyses and visualisations to enhance Exploratory Learning
  - for students, teachers, researchers, policy makers, administrators etc.

Acknowledgements

- MiGen project team – see www.migen.org and References (design of eXpresser microworld, student feedback, Teacher Assistance tools)
- Veronica Cucuiat, Rose Luckin, Mutlu Cukurova (design of learning analytics for teachers using SAM labs)

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