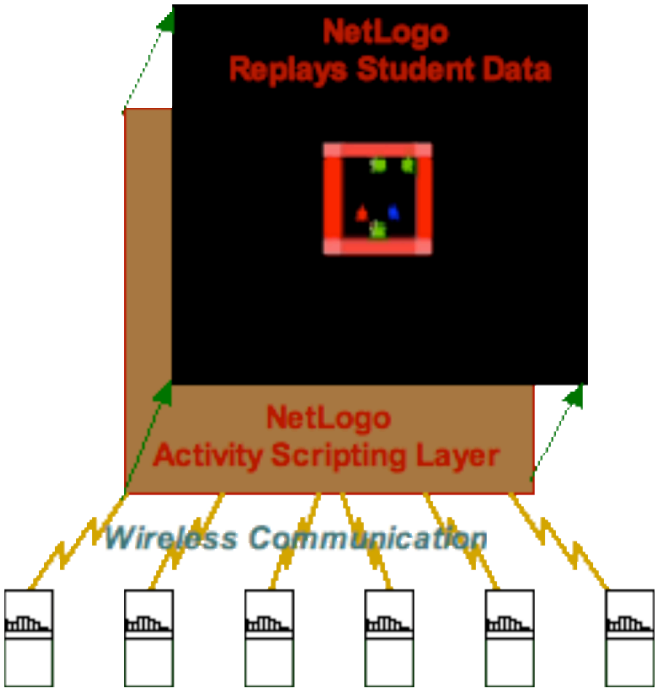

Figure 10: NetLogo Activity Scripting Layer can Import Student Data to be Replayed in NetLogo Modeling Layer

For the replay, the data from each student can be imported into an agent (see colored agents in Figure 10). These agents then would be confined to move in a container where their speeds would come from the student motion data and the directions would be randomly assigned. Agents would also "bounce" of f the walls in the model. The sense is that this re-enactment in the NetLogo environment would provide additional scaffolding between the embodied student experience and the interpretation of the GasLab model of an ideal gas. Although the students would not be controlling the NetLogo agents in real-time like they do in the Gridlock simulation, there would still be the sense in which their embodied movements with the motion detectors were controlling cybernetic agents. There would be a succession of kinds of embodiment from moving around in a room, to having that motion be rendered in a computer model, to having students explore the embodied rules for agents that animate the NetLogo model of an ideal gas. At the level of aggregate analysis there is also a movement from a histogram of motion in a room, to an evolving histogram in NetLogo of the "replay" of their motions, to making sense of the histograms associated with the GasLab model and, by extension, real gas molecules in the classroom.

Future Directions

As indicated above, the HubNet architecture is in a preliminary stage. Significant project resources are allocated to developing HubNet and completing the fully networked architecture. Alongside this iterative design research, we will continue to conduct both implementation and curricular research with successive versions of HubNet. We have begun to design and test a set of PSA using ClassLogo that make use of sophisticated new content domains. This fundamental research is being carried out in economically challenged inner-city schools. Significant resources from the PSP Project are going toward site-based support and innovation. We are working alongside the teachers in targeting and implementing network-based participatory simulations that can transform students' understanding of core concepts of the current curriculum (e.g. the concept of function) even as fundamentally new systems-understandings and content areas are introduced.

In this context, we seek to gain a better understanding of how a PSA can significantly advance student understanding of the unfolding dynamics of systems. We hope to shed light on how learners' intuitive understandings and ways of responding interact with rule-based, embodied (e.g., StarLogoT, NetLogo) and aggregate (e.g., STELLA) modeling environments. Through this design, implementation and curricular research, we hope to further the goal of advancing systems related understanding for *all* students.

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