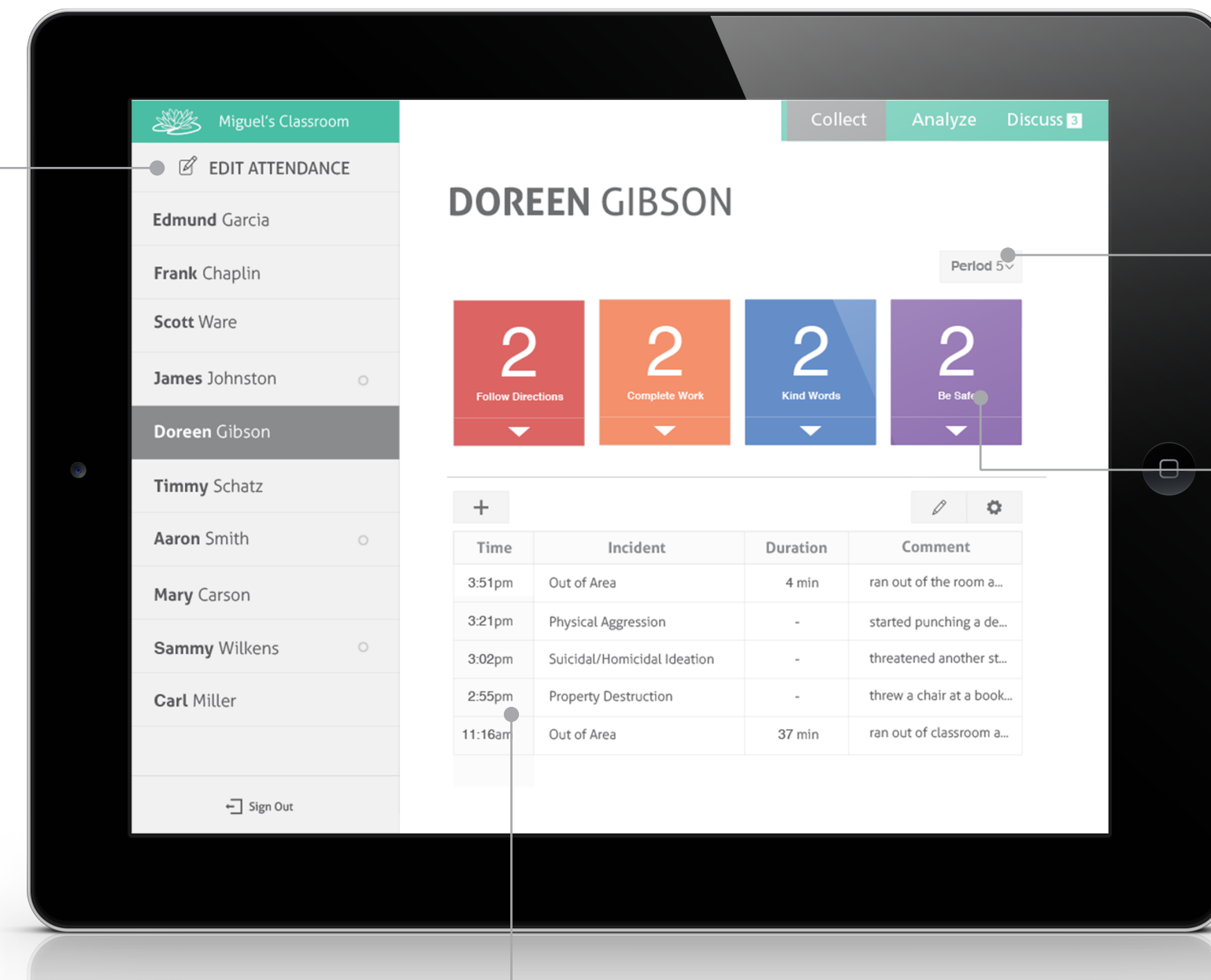


## THE LILYPAD SYSTEM: SUPPORTING COLLABORATIVE REFLECTION

Collaboration in special education requires integrating a child's data from different sources, reviewing changes in the data over time, and drawing from the knowledge of different practitioners to interpret these changes and make decisions. We call this data-driven process collaborative reflection. It enables decision-making over time based on what data reveals about the effects of behavioral interventions. Staff and also reflect on data individually, but ultimately this reflection is in support of the collaboration needed for a treatment team to make decisions about interventions. Prior research has focused on supporting healthcare teams primarily by providing tools for structured work practices. In this work, we investigate the *ad hoc*, unstructured aspects of teamwork and address the need for tools that enable this type of work. We investigated collaborative reflection among teams providing mental and behavioral health services to children with special needs, as part of a special education program. From our findings emerged the concept for a system to support data collection and collaborative reflection. We engaged the teams in participatory design to develop the LilyPad system.

### ATTENDANCE

Quick editing of period-by-period attendance. Automatic progression from one period to the next. Accurate attendance tracking makes recording of in-the-moment data accurate and reliable.



### PERIOD ATTENDANCE

Automatic progression from one period to another makes it simple to collect current data. Data from periods can be viewed and modified with a few quick clicks.

### POINT SYSTEM

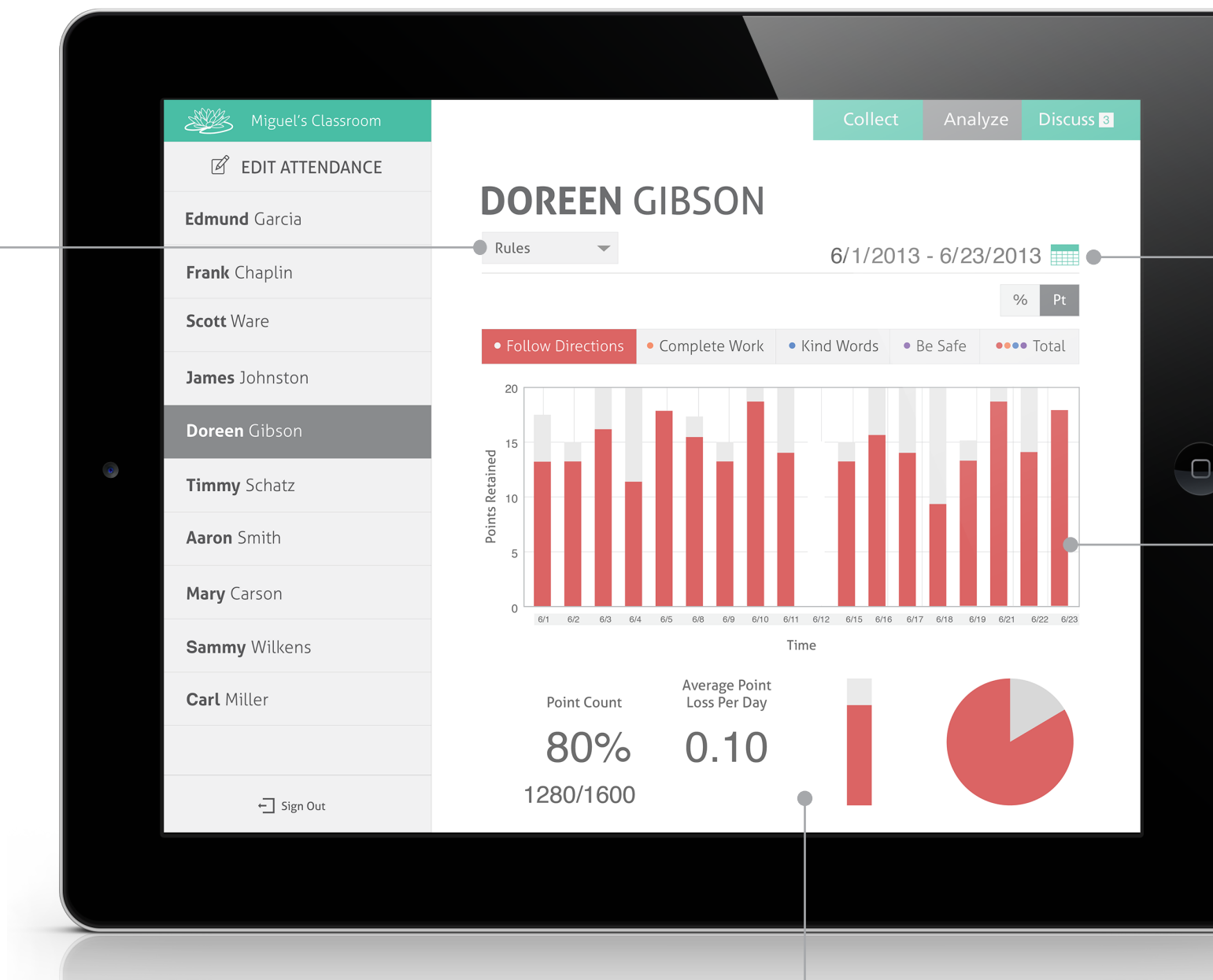
One of the most important interactions with LilyPad is the collection of data. Designed to be large and central to the collect feature, the point system widgets can be quickly viewed at a glance and readily edited with one touch. This functionality is introduced in a flexible and open-ended way to allow users to appropriate it within their existing practices.

### INCIDENT LOG

This log tracks single incidents that occur throughout the day. These incidents are categorized outside of the 4-point system. The data is recorded with time of occurrence, duration, and comments for later review.

### ANALYSIS SCREENS

All the data collected, from points to attendance, can be viewed in the Analyze tab. This way, there is one centralized place for all data and analyses to be viewed.



### DATE SELECTION

Specific periods can be selected such that treatment periods designated by the school or customizable time spans can be selected for viewing data.

### BAR CHART

Users are able to view data collected over a selected period of time. This allows users to make sense of the data and view trends that may appear over time.

### MORE VISUALIZATIONS

Multiple visualizations of the same data allow for better absorption of the data and lessen the chance for misinterpretation. This section allows for users to zero in on specific behaviors of a student for better analysis.

## RECORD

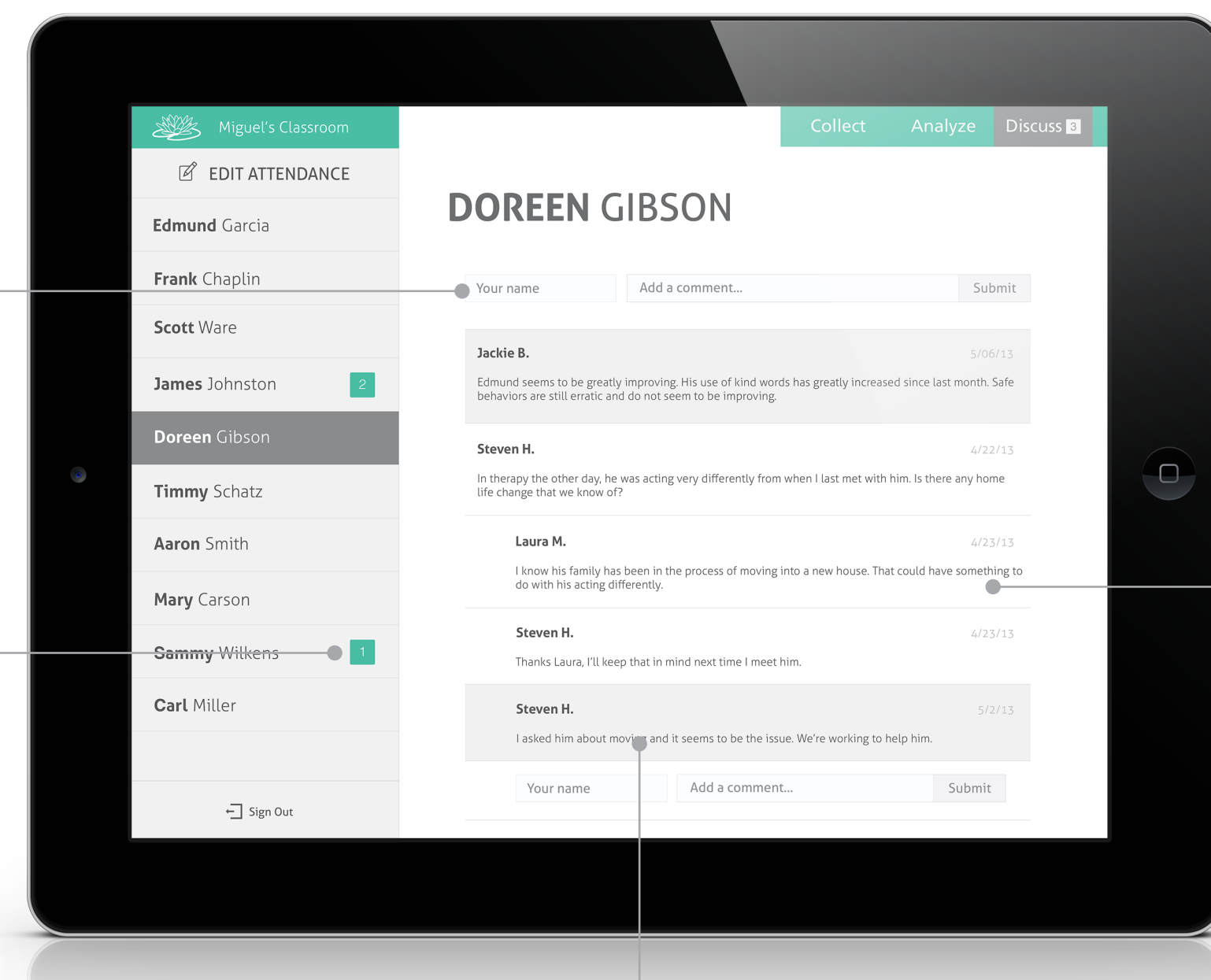
Practitioners need a data collection system that is less cumbersome and time-consuming than paper-based data sheets. There is also an opportunity to improve consistency in data collection. Issues with consistency stem from data being collected separately by different practitioners, and efforts to maintain consistency are limited to staff training at beginning of the year followed by occasional reliability checks.

## REFLECT

There is significant opportunity for improving visualizations of data to support both individual and collaborative reflection. Existing paper-based data management enables little more than scatterplots created by hand. However, the novelty of data visualization, analytics, and statistics for many practitioners makes the design and introduction of this functionality challenging.

### NEW DISCUSSIONS

Adding new discussions is simple and direct. Just type in the user's name, discussion message, and hit submit.



### NOTIFICATION

If there is an unread message in a discussion for a particular student, the user will get a notification next to that student's name.

### DISCUSSION COMMENTS

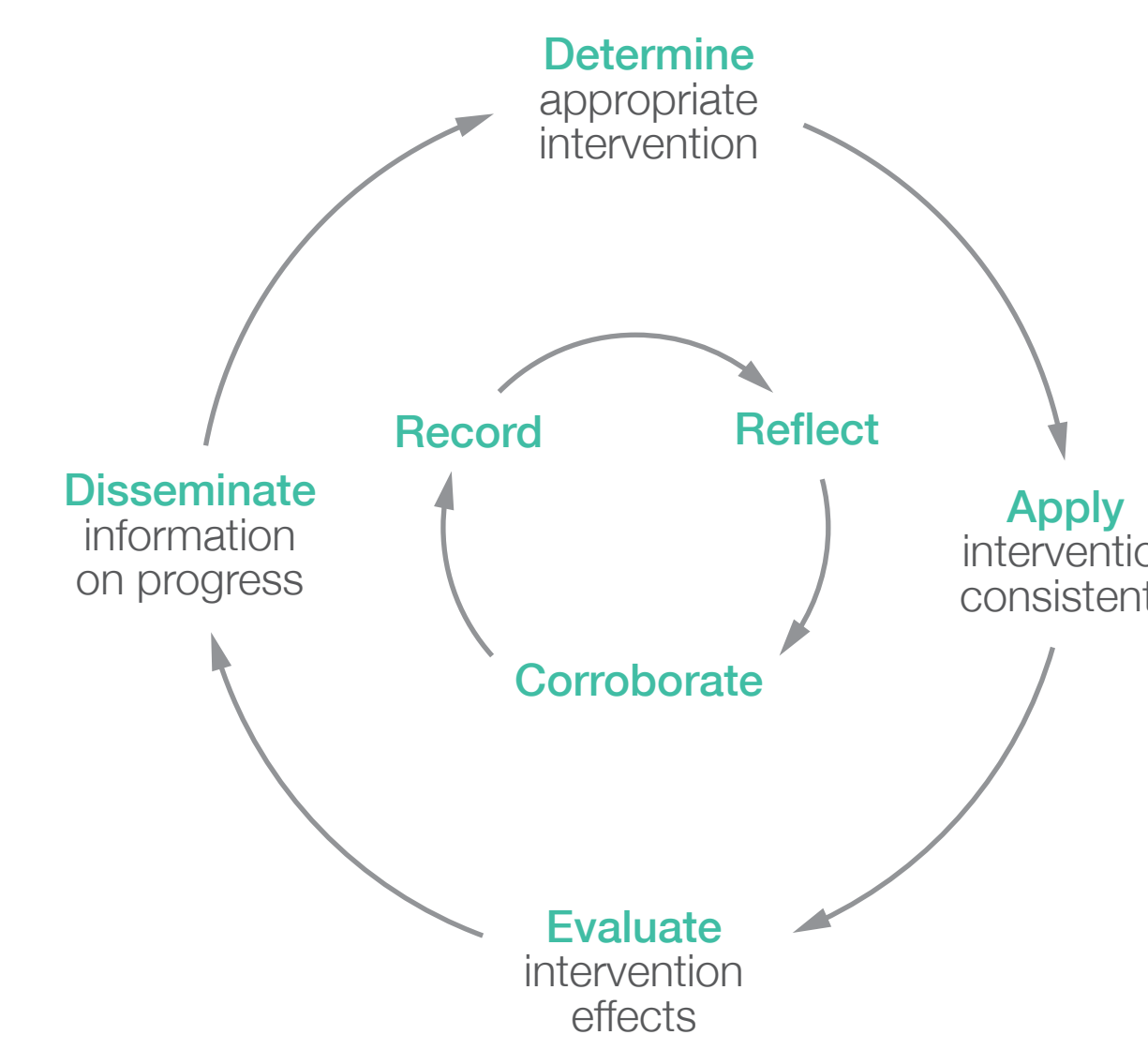
Comments within a discussion are stacked and indented for easy viewing and collapsability.

### STATUS OF DISCUSSION

Discussions that have been updated will be moved to the top of the list and turn green. Discussions that have been read will be in gray.

## CORROBORATE

Practitioners often discuss data to corroborate their interpretations of what is going on with a patient. These discussions happen primarily during everyday informal interactions, when data may not be at hand—e.g., a conversation between two practitioners across the room while they are working with different children, or a discussion when two practitioners run into one another in the hallway. Corroboration could be improved by making data accessible in this type of context to support informal interactions.



### COLLABORATIVE REFLECTION

The treatment teams were reflecting on a child's data together by sharing their knowledge and understanding of that child's progress, in order to corroborate their interpretations and make decisions about how to adjust interventions going forward.

The long-term outer loop shows four collaboration points over time, where team members have reciprocal interdependence. First, practitioners reflect on patient data to understand the needs of the patient and *determine an appropriate intervention* to move forward with. Second, multiple practitioners may be involved with an intervention, so reflecting on patient data can help practitioners *apply the intervention consistently*—for example by comparing patient responsiveness and immediate progress with different practitioners, or sharing successful strategies for applying the intervention and working with that patient. Third, practitioners *evaluate the effects of an intervention* by reflecting on the patient's data over time. Fourth, practitioners disseminate information on the patient's progress to others on the team, to practitioners not on the team, or to caregivers or family members.

The short-term inner loop shows how interdependent team members work together everyday to develop a shared understanding, which they draw on to make ongoing treatment decisions. Team members *record* data, *reflect* on the data both individually and collaboratively, and *corroborate* interpretations of the data with others.

### THE LILYPAD SYSTEM

We have developed a system to support collaborative reflection through a network of iPads used by members of a collocated team. We named this system LilyPad to convey the notion of independent points of interaction with data that also belong to an interconnected ecosystem for data management. In other words, a practitioner is aware that while she uses her LilyPad (or iPad) to record and reflect on her data, she also has the ability at her fingertips to connect with other practitioners to corroborate interpretations of that data and initiate discussion. Team members' LilyPads are connected, and help them to be more connected for *ad hoc* collaboration.

The LilyPad system will be evaluated in a 3-month deployment study. We will use observation, interviews, and surveys to investigate whether the LilyPads help practitioners to reflect on data more both individually and collaboratively. We will look at impromptu interaction and scheduled meetings to see whether data use is different in these settings. System logs will also be used to understand which features are used most, when, and by whom.