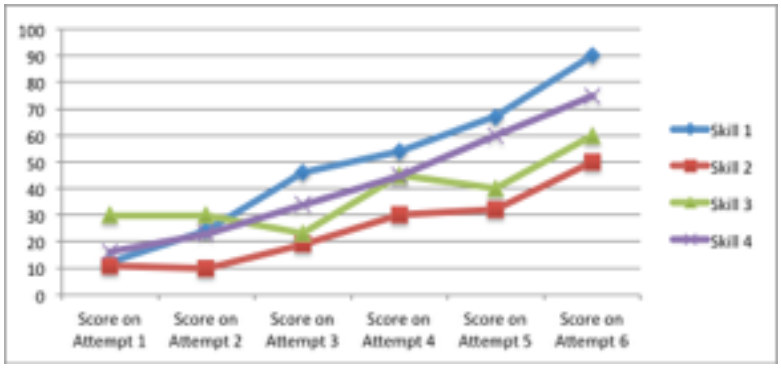
Data Supplement S1. Examples of Learning Analytics

Example Data Set

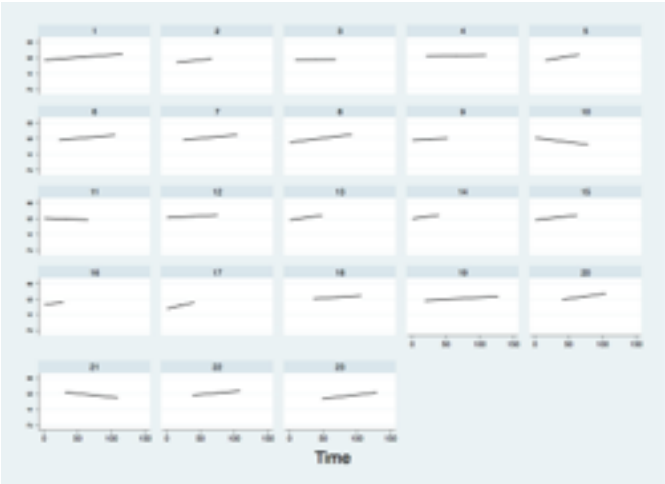
Skill	Score on Attempt 1	Score on Attempt 2	Score on Attempt 3	Score on Attempt 4	Score on Attempt 5	Score on Attempt 6	Average Score
Skill 1	12	24	46	54	67	90	48.8/100
Skill 2	11	10	19	30	32	50	25.3/100
Skill 3	30	30	23	45	40	60	38.0/100
Skill 4	16	23	34	45	60	75	42.2/100

Example 1. Learning Progress (a.k.a. "Learning Curve")

This is an example of documenting the progression of a learner's score over time. Some skill-based learning will have a more obvious and classic S-shaped curve, and some skills may have a more gradual increase over time.



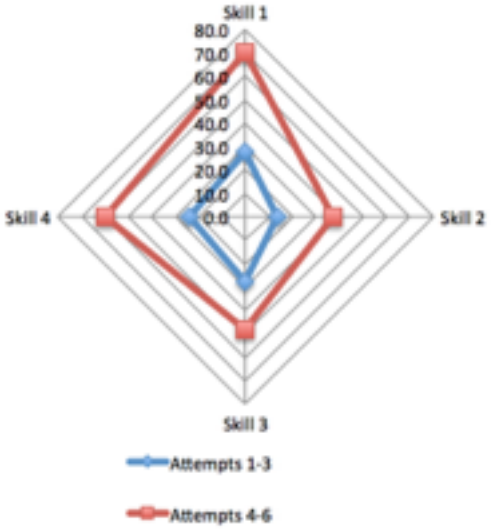
Example 2. Learning Trajectories (i.e. regression-prediction modelling based on previous progress)



Depending on the variables measured an input into the model, these regression-based models may allow educators to begin explain observed trends in performance. Imagine that you could accrue a year's worth of the data listed in our example data set and use it to model the likely performance on the next attempt. Such modelling has also been used in other fields predict future performance, and this may be useful for anticipating trainee performance. The examples to the left are 23 such trajectories over months for some PGY2 residents (without adjusting for rater properties or other contextual matters). Artificial intelligence (a.k.a. machine learning algorithms) may also be useful in these contexts to generate even more refined probabilistic models of future performance.

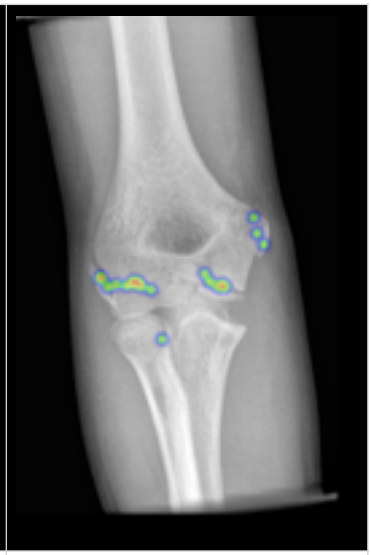
Example 3. Radar Plot

This is an example for the above data set that averages the scores over 6 attempts and then plots each skill domain along the four axes. To keep this type of plot clean this requires some "binning" of data (i.e. collapsing of datapoints), since on each axis you would want only a few values. For instance, you could have one single point representing the average over the first 6 attempts, or you could have two points, representing the average of the first 3 attempts, and the later attempts – allowing one to compare two "bins" of data for a single trainee, differentiated by experience/exposure.

	
Average score of all 6 attempts.	Average score of the first 3 attempts, and the last three attempts.

Example 4. Heat Mapping

A pediatric elbow radiograph rated by learners as to whether it has a fracture or not (it does NOT). Indicated in the heat map are the false positives wherein a learner indicated a fracture that was actually a normal feature of the developing elbow. Learning analytics include novel visualizations such as these that shed light on learner cognition and behavior. (Images courtesy of Martin Pecaric, ImageSim, Toronto, Canada)

	
ABNORMAL - FRACTURE	NORMAL

Another example of heat mapping might be to apply a simple conditional formatting condition to your dataset. At a glance, a reader can see that there is a general trend towards higher scores with successive attempts, and that it seems like Skill 2 or 3 are not progressing as fast (since the color gradient is not as dramatic).

Skill	Score on Attempt 1	Score on Attempt 2	Score on Attempt 3	Score on Attempt 4	Score on Attempt 5	Score on Attempt 6
Skill 1	12	24	46	54	67	90
Skill 2	11	10	19	30	32	50
Skill 3	30	30	23	45	40	60
Skill 4	16	23	34	45	60	75