**Power calculation**

This is a power calculation for sample size required to observe differences in learning outcomes between interactive visualisation control and experimental game groups.

# Summary

We should recruit 80 participants per group to capture a meaningful improvement with reasonable power over a range of possible outcomes.

Outcome measure information:

|  |  |  |
| --- | --- | --- |
| **Test name** | **Score range** | **Score meaning** |
| Intended learning outcome MCQ | 0 - 24 | Each point of score represents a learning outcome that the participant successfully learned |

# Priors

## Data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Study** | ***n*** | **mean** | **SD** | **min** | **max** |
| Pilot testing (of intended learning outcome MCQ) | 6 | 13.84 | 1.77 | 11.27 | 15.6 |

## Effect size estimation

|  |  |  |
| --- | --- | --- |
| **Variable to estimate** | **How it was estimated** | **Notes** |
| Control group mean | Estimated from pilot testing data | Pilot test results reflect baseline performance (i.e., no period of learning before assessment) and so control/experimental means are assumed to be higher. *This may affect SD estimation (see below)*. |
| Experimental group mean | Minimum meaningful improvement | The minimum meaningful improvement to warrant spending extra resources gamifying an interactive visualisation is estimated at an average improvement of half a point. This would mean that half the learners who use the game learn an additional learning outcome compared with interactive visualisation controls. |
| Standard deviation | Estimated from pilot testing data | Modelling accounts for both a static SD of 1.77 and a variable SD of 12.8% of the mean. |
| Accepted alpha / power levels | Minimum of a = 0.05 / p = 80% |  |

# Power analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Control group mean** | **Standard deviation** | **Experimental group mean** | **Alpha / Power** | **Group size** |
| 13.84 | 1.77 (static) | 14.84 (+1 ILO) | 0.05 / 80% | 49 |
|  |  |  | 0.05 / 90% | 81 |
|  |  |  | 0.01 / 95% | 112 |
|  |  | 14.34 (+½ ILO) | 0.05 / 80% | 197 |
| 17.84 | 2.28 (variable) | 18.84 (+1 ILO) | 0.05 / 80% | 82 |
|  |  |  | 0.05 / 90% | 109 |
|  |  |  | 0.01 / 90% | 155 |
|  |  | 18.34 (+½ ILO) | 0.05 / 80% | 326 |