#### Indicators for procedural fluency, conceptual understanding and adaptive reasoning Debbie Stott, South African Numeracy Chair

Mathematical proficiency is a key construct for research question one and for broader work in the SANC project. In order to link learner mathematical progress to Kilpatrick et al.’s (2001) strands of mathematical proficiency, I drew on their work to find broad indicators to guide observations I made for each learner from their MP interview scripts. This search resulted in my summarising the indicators for *conceptual understanding, procedural fluency* and *adaptive reasoning*. *Strategic competence* and *productive disposition* are not included because although the MP interview does include some tasks that are number stories (see Tasks 13 and 14 in Appendix B), these tasks did not reveal enough about strategic competence to enable analysis of learners’ proficiency in this respect. The number stories are simply word sums, which the learners need to make sense of within the confines of interview process. Therefore, I have not considered strategic competence in my observations. Neither have I included the productive disposition strand, as this is not a specific focus for my study and is therefore not assessed in either of the instruments used[[1]](#footnote-1).

These are the indicators that I looked for whilst analysing data from the MP interviews:

* *Conceptual understanding*: ability to use multiple representations, estimating, making connections and links and understanding properties of number systems (i.e. number sense).
* *Procedural fluency*: ability to solve a problem without referring to tables and other aids, using efficient ways to add, subtract, multiply and divide mentally and on paper, understanding when it is appropriate to use procedures or not (as not all calculating situations are alike). In addition, as discussed previously in Chapter Two, I looked at “elements of fluency” which includes knowing basic facts and knowing basic methods (Askew, 2012a, p. 55[[2]](#footnote-2)).
* A*daptive reasoning*: being able to give informal explanations and justifications for one's work, intuitive reasoning based on pattern, thinking logically about the relationships amongst concepts and determining whether the use of a particular procedure is appropriate or not for the context i.e. being able to adapt the problem solving approach to the context.

These indicators for conceptual understanding, procedural fluency and adaptive reasoning and the structure of the LFIN (Wright et al., 2006[[3]](#footnote-3)) provide the analysis framework, tools and language to discuss learners’ mathematical proficiency for the data collected from the MP interviews. I now look at the analysis strategies used for the fluency assessment data.

1. Productive disposition is examined in other research studies carried out by the SANC project. See for example: Graven, Hewana & Stott (2013) and Graven (2012). [↑](#footnote-ref-1)
2. Askew, M. (2012a). Transforming primary mathematics. Abingdon: Routledge. [↑](#footnote-ref-2)
3. Wright, R. J., Martland, J., & Stafford, A. K. (2006). Early numeracy: assessment for teaching and intervention. London: Sage Publications Ltd.

   Wright, R. J., Martland, J., Stafford, A. K., & Stanger, G. (2006). Teaching Number: Advancing children’s skills and strategies (2nd ed., p. 244). London: Paul Chapman Publishing Ltd. [↑](#footnote-ref-3)