Subtraction Research

1. It is almost impossible to develop procedural fluency with multi-digit algorithms without strong base ten understanding. Students do not need to develop place value understanding before performing multi-digit computation. Rather, the two go hand in hand and should be developed simultaneously, and consistently used to deepen understanding of each other. (Adding it Up, NRC, 2000)
2. When students fail to grasp the concepts that underlie procedures, they frequently generate flawed procedures that result in systematic errors, which teachers mistakenly recognize as “silly errors”. (Dossey et al, 2008)
3. Understanding and fluency are related. Given conventional instruction that emphasizes practicing procedures, void of an ongoing revisiting of conceptual structures, a substantial percentage of students will not be successful in subtraction. (Ritchart, 2005)
4. Subtraction is made more difficult by the impossibility of maintaining the model as a referent. For example, when solving 73 – 26 with base ten blocks, the 73 is represented with 7 tens blocks and 3 ones blocks. In order to take away 26, the model 73 must be changed, making the ability to refer to the original model and keep track of the steps to solve the problem, challenging for many students. (van de walle, 2010)
5. Given time to develop meaning for a model and then connect a written procedure to it, students have shown high levels of performance using both written and mental procedures and the ability to fall back on the model to help explain their answers. (van de walle, 2010)
6. Algorithms should grow out of physical models versus physical models being used to justify an algorithm. (Van de Walle, 2010)
7. The act of inventing algorithms and comparing and contrasting them, is a kind of problem solving that has the greatest influence on understanding. Procedural fluency is built directly on understanding. Students who invent their own correct procedures have been proven to have strong procedural fluency. (Russell, Economopolous, and Bastable, 2007)
8. The best way to solve a problem is dependent on the numbers and the situation. *(Van de Walle, 2010)*
9. Multi-digit subtraction is heavily influenced by instruction. Rich, effective instruction in subtraction is often hindered by teachers’ inflexibility with multi-digit subtraction. (Adding It Up, NRC, 2000)
10. A teacher’s ability to teach subtraction is the second most common reason (flexible place value understanding is the first) students are tangled with multi-digit subtraction. While they are comfortable with their own ability to do subtraction with regrouping and describe the procedure, they are far less articulate with the conceptual underpinnings of subtraction…

(Ball, Shram, and Fieman-Nemser, 2009)