

**Supplemental material: Effects of formative assessment on intrinsic motivation in primary school mathematics instruction**

**Results of model estimation**

**Table 1**

*Direct effects for model 1 (hypotheses 1-3) and model 2 (research question 4) after excluding data of class (1)*

| model | Dependent variable | predictor      | $\beta$ | SE   | z     | p       |
|-------|--------------------|----------------|---------|------|-------|---------|
| 1)    | Motivation T2      | LPA vs. CG     | 0.06    | 0.10 | 0.53  | .299    |
|       |                    | LPA+ vs. CG    | 0.10    | 0.08 | 1.18  | .119    |
|       |                    | Motivation T1  | 0.17    | 0.06 | 2.97  | .002*   |
|       |                    | PCS T1         | 0.22    | 0.05 | 4.78  | <.001** |
|       | PCS T2             | LPA vs. CG     | 0.29    | 0.14 | 2.06  | .020*   |
|       |                    | LPA+ vs. CG    | 0.30    | 0.17 | 1.83  | .034*   |
|       |                    | Achievement T1 | -0.11   | 0.05 | -2.26 | .012*   |
|       |                    | PCS T1         | 0.41    | 0.05 | 7.51  | <.001** |

**Supplemental material: Effects of formative assessment on intrinsic motivation in primary school mathematics instruction**

| model | Dependent variable | predictor                    | $\beta$ | SE   | z     | p       |
|-------|--------------------|------------------------------|---------|------|-------|---------|
| 2)    | Motivation T2      | LPA vs. CG                   | 0.06    | 0.10 | 0.54  | .296    |
|       |                    | LPA+ vs. CG                  | 0.09    | 0.08 | 1.06  | .144    |
|       |                    | Motivation T1                | 0.17    | 0.06 | 2.94  | .002*   |
|       |                    | PCS T1                       | 0.21    | 0.05 | 4.73  | <.001*  |
|       |                    | Achievement T1               | 0.03    | 0.04 | 0.87  | .191    |
|       |                    | Achievement T1 X PCS T1      | 0.00    | 0.03 | 0.16  | .876    |
|       | PCS T2             | LPA vs. CG                   | 0.29    | 0.14 | 2.08  | .019*   |
|       |                    | LPA+ vs. CG                  | 0.25    | 0.17 | 1.48  | .070    |
|       |                    | PCS T1                       | 0.41    | 0.05 | 7.73  | <.001** |
|       |                    | Achievement T1               | -0.18   | 0.08 | -2.26 | .012*   |
|       |                    | LPA vs. CG X Achievement T1  | 0.06    | 0.09 | 0.66  | .509    |
|       |                    | LPA+ vs. CG X Achievement T1 | 0.28    | 0.12 | 2.38  | .018*   |

*Note.*  $N = 588$ ,  $R^2_{MotModel1} = 0.16$ ,  $R^2_{PCSMModel1} = 0.16$ ,  $R^2_{MotModel2} = 0.16$ ,  $R^2_{PCSMModel2} = 0.17$ , CG = control group, LPA= learning progress assessment, LPA+ = learning progress assessment plus support, PCS = perceived competence support, T1 = pre-test, T2 = post-test, \* $p < .05$ ; \*\* $p < .001$ .

**Supplemental material: Effects of formative assessment on intrinsic motivation in primary school mathematics instruction**

**Table 2**

*Direct effects for model 1 (hypotheses 1-3) and model 2 (research question 4) after excluding data of classes (1) and (2)*

| model | Dependent variable | predictor      | $\beta$ | SE   | z     | p       |
|-------|--------------------|----------------|---------|------|-------|---------|
| 1)    | Motivation T2      | LPA vs. CG     | 0.06    | 0.10 | 0.54  | .294    |
|       |                    | LPA+ vs. CG    | 0.11    | 0.09 | 1.28  | .100    |
|       |                    | Motivation T1  | 0.16    | 0.06 | 2.61  | .005*   |
|       |                    | PCS T1         | 0.23    | 0.05 | 4.89  | <.001** |
|       | PCS T2             | LPA vs. CG     | 0.29    | 0.14 | 2.07  | .020*   |
|       |                    | LPA+ vs. CG    | 0.32    | 0.17 | 1.82  | .035*   |
|       |                    | Achievement T1 | -0.11   | 0.05 | -2.19 | .015*   |
|       |                    | PCS T1         | 0.41    | 0.06 | 7.35  | <.001** |

**Supplemental material: Effects of formative assessment on intrinsic motivation in primary school mathematics instruction**

| model | Dependent variable | predictor                    | $\beta$ | SE   | z     | p       |
|-------|--------------------|------------------------------|---------|------|-------|---------|
| 2)    | Motivation T2      | LPA vs. CG                   | 0.06    | 0.10 | 0.55  | .290    |
|       |                    | LPA+ vs. CG                  | 0.10    | 0.09 | 1.17  | .122    |
|       |                    | Motivation T1                | 0.16    | 0.06 | 2.59  | .005*   |
|       |                    | PCS T1                       | 0.23    | 0.05 | 4.85  | <.001*  |
|       |                    | Achievement T1               | 0.04    | 0.04 | 0.95  | .172    |
|       |                    | Achievement T1 X PCS T1      | 0.01    | 0.03 | 0.19  | .850    |
|       | PCS T2             | LPA vs. CG                   | 0.29    | 0.14 | 2.09  | .019*   |
|       |                    | LPA+ vs. CG                  | 0.25    | 0.17 | 1.46  | .072    |
|       |                    | PCS T1                       | 0.41    | 0.05 | 7.60  | <.001** |
|       |                    | Achievement T1               | -0.18   | 0.08 | -2.23 | .013*   |
|       |                    | LPA vs. CG X Achievement T1  | 0.06    | 0.09 | 0.66  | .511    |
|       |                    | LPA+ vs. CG X Achievement T1 | 0.31    | 0.12 | 2.58  | .010*   |

*Note.*  $N = 569$ ,  $R^2_{MotModel1} = 0.16$ ,  $R^2_{PCSMModel1} = 0.16$ ,  $R^2_{MotModel2} = 0.16$ ,  $R^2_{PCSMModel2} = 0.17$ , CG = control group, LPA= learning progress assessment, LPA+ = learning progress assessment plus support, PCS = perceived competence support, T1 = pre-test, T2 = post-test, \* $p < .05$ ; \*\* $p < .001$ .

**Supplemental material: Effects of formative assessment on intrinsic motivation in primary school mathematics instruction**

**Information on implementation fidelity**

**Table 3**

*Self-report ratings of implementation fidelity*

| group | teacher | self-report on implementation fidelity ( <i>M</i> ) |                     |          |                      |
|-------|---------|-----------------------------------------------------|---------------------|----------|----------------------|
|       |         | quop                                                | supplementary tests | feedback | adaptive instruction |
| LPA+  | 1       | 2.50                                                | 3.20                | 2.71     | 3.00                 |
|       | 2       | n.a.                                                | n.a.                | n.a.     | n.a.                 |
|       | 3       | 3.25                                                | 3.00                | 3.14     | 2.75                 |
|       | 4       | 3.00                                                | 3.20                | 4.00     | 4.00                 |
|       | 5       | 3.25                                                | 2.80                | 2.86     | 3.25                 |
|       | 6       | 2.5                                                 | 3.00                | 1.57     | 1.50                 |
|       | 7       | 3.00                                                | 2.80                | 2.29     | 2.00                 |
|       | 8       | 3.50                                                | 3.00                | 2.43     | 2.50                 |
|       | 9       | 3.50                                                | 3.20                | 2.71     | 2.75                 |
| LPA   | 1       | n.a.                                                |                     |          |                      |
|       | 2       | 3.00                                                |                     |          |                      |
|       | 3       | 2.75                                                |                     |          |                      |
|       | 4       | 3.00                                                |                     |          |                      |
|       | 5       | 2.50                                                |                     |          |                      |
|       | 6       | 3.50                                                |                     |          |                      |
|       | 7       | 2.75                                                |                     |          |                      |

*Note.* LPA+ = learning progress assessment plus support, LPA= learning progress assessment, n.a. = not available.

**Supplemental material: Effects of formative assessment on intrinsic motivation in primary school mathematics instruction**

**Table 4**

*Teachers' feedback practices*

| aspect of learning promotive feedback                         | mean score |
|---------------------------------------------------------------|------------|
| reporting strengths                                           | 1.84       |
| reporting weaknesses                                          | 1.75       |
| number of weaknesses reported                                 | 1.69       |
| providing strategies                                          | 0.58       |
| providing detailed strategies                                 | 0.45       |
| assignment of weaknesses and strategies                       | 0.67       |
| setting learning goals                                        | 1.20       |
| feedback is given at self-level (*should not be used)         | 0.19       |
| referring to task level                                       | 0.98       |
| referring to process level                                    | 1.02       |
| Referring to self-regulatory level                            | 0.25       |
| socially comparative reference standard (*should not be used) | 0.25       |
| criterial reference standard                                  | 1.73       |
| individual reference standard                                 | 1.70       |
| comprehensibility                                             | 2.00       |
| specificity                                                   | 1.75       |
| motivating attribution pattern                                | 1.16       |
| use of learning map                                           | 1.78       |
| feedback in groups                                            | 1.06       |

*Note.* the presence or absence of the respective characteristics were rated (0 = “characteristic not available”, 1 = “characteristic partially available”, 2 = “characteristic available”).