

Teacher IKMA (Integrated Knowledge and Motivation Assessment: Multiplicative Reasoning)

Project STAIR

Technical Report #02

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Purpose

The purpose of this technical report is to examine changes in teachers' content knowledge and motivation on multiplicative reasoning before and after the implementation of Project STAIR.

Method

A total of 14 Project STAIR middle school teachers took the *Integrated Knowledge and Motivation Assessment: Multiplicative Reasoning* (IKMA-MR; Jacobson & Izsak, 2010) assessment. Among 14 teachers, only the six who completed both pre- and post were included in the analyses reported here. Three of those were from the treatment group, and the other three were from the control group.

Measures

The IKMA-MR assessment includes eight pairs of questions, 16 questions total. The first question in each pair presented a classroom scenario, and the second question was a Likert scale asking about teachers' perceived knowledge and ability to handle the scenario. The first question in each pair asked the respondent about how a student might work through the problem discussed in the scenario. Four questions asked them to choose the option that best characterizes a student's technique for finding the answer. The other four questions presented several ways a student might work through the problem and asked which of the methods displayed or described will work and which methods will not. The Likert scale questions were consistent throughout the survey and measured teachers' perceptions of and motivation on effective teaching practices and multiplicative reasoning. Questions included:

- Knowing how to answer questions like this is one of the most important things you need to know to be a good mathematics teacher (indicator 1),
- I am good at answering questions like this one (indicator 2),
- I often feel nervous when I try to answer questions like this one (indicator 3), and

- If I try hard, I can usually figure out questions like this one (indicator 4).

Procedures

This survey was administered at two time points, at the beginning and end of implementation for two groups: a treatment group who received a treatment, and a control group, who did not. This survey took teachers on average 40 minutes to complete. For the analysis, the first question in each pair which assess teachers' content knowledge in multiplicative reasoning were coded as '1' for correct answer, and '0' for all others. The second questions which assess teachers' perceptions of and motivation on effective teaching practices and multiplicative reasoning using four-point Likert scale (i.e., 'Strongly disagree', 'Disagree', 'Somewhat disagree', 'Neither agree nor disagree', 'Somewhat agree', 'Agree', 'Strongly agree') were coded as 1, 2, 3, 4, 5, 6, 7 for each category of responses.

Results

Teachers' content knowledge in multiplicative reasoning

First, descriptive statistics of *content knowledge in multiplicative reasoning* were provided (see Table 2.1). For treatment group ($n = 3$), the mean score was 1.66 ($SD = 0.57$) at pretest and 2.66 ($SD = 0.57$) at posttest. For control group ($n = 3$), the mean score was 1.33 ($SD = 1.52$) at pretest and 1.66 ($SD = 1.52$) at posttest.

Table 2.1

Descriptive Statistics of Treatment and Control Group Content Knowledge in Multiplicative Reasoning at Pre- and Posttest

Variable	Treatment group			Control group		
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>
Pretest	3	1.66	0.57	3	1.33	1.52
Posttest	3	2.66	0.57	3	1.66	1.52

Second, to evaluate whether treatment and control group differed significantly on *content knowledge in multiplicative reasoning* at pre- and posttest, Mann-Whitney U test was conducted. Note that we used nonparametric *t*-test since the data did not meet the assumption about normal distribution. Before the analysis, to test the assumptions of homogeneity of variance, nonparametric independent *t*-test were conducted (see Table 2.2). The significance value of at pre-test was more than .05, we accepted the null hypothesis for the assumption of group's variance and concluded that there is no significant difference between treatment and control group.

Table 2.2

Mann-Whitney U test for Comparing the Means at Pretest for Treatment and Control group to Test Homogeneity on Content Knowledge in Multiplicative Reasoning

Variable	Treatment group			Control group			z	p
	n	M	SD	n	M	SD		
Pretest	3	1.67	0.57	3	1.33	1.52	-.44	.65

Table 2.3 present the result of Wilcoxon test on *content knowledge in multiplicative reasoning* at pre- and posttest for treatment group and control group. For treatment group, the result showed that there was no significant difference in the pre- and posttest, $z = -1.37$, $p = 0.18$. For control group, the result showed that there was no significant difference in the pre- and posttest, $z = .00$, $p = 1.00$.

Table 2.3

Wilcoxon test on Content Knowledge in Multiplicative Reasoning for Treatment and Control Group

Group	Pretest			Posttest			z	p
	n	M	SD	n	M	SD		
Treatment group	3	1.66	0.57	3	2.66	0.57	-1.34	.18

Control group	3	1.33	0.57	3	1.66	1.52	.00	1.00
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Teachers' perceptions of and motivation on effective teaching practices and multiplicative reasoning

First, descriptive statistics were conducted on teachers' *perceptions of and motivation on effective teaching practices and multiplicative reasoning* at pre- and posttest for both treatment and control group (see Table 2.4). For treatment group ($n = 3$), the mean score was 6.00 ($SD = 0.28$) at pretest and 5.93 ($SD = 0.31$) at posttest. For control group ($n = 3$), the mean score was 5.40 ($SD = 0.72$) at pretest and 4.77 ($SD = 0.50$) at posttest.

Table 2.4

Descriptive Statistics of Treatment and Control Group Content Knowledge in Teacher's Perceptions of and Motivation in Effective Teaching Practices and Multiplicative Reasoning

Variable	Treatment group			Control group		
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>
Pretest	3	6.00	0.28	3	5.40	0.72
Posttest	3	5.93	0.31	3	4.77	0.50

1- strongly disagree, 2- disagree, 3- somewhat disagree, 4- neither agree nor disagree, 5- somewhat agree, 6- agree, 7- strongly agree.

Second, to evaluate whether treatment and control group differed significantly on *perceptions of and motivation on effective teaching practices and multiplicative reasoning* at pre- and posttest *Mann-Whitney U test* was conducted. Note that we used nonparametric *t*-test since the data did not meet the assumption about normal distribution. Before the analysis, to test the assumptions of homogeneity of variance, nonparametric independent *t*-test were conducted (see Table 2.5). The significance value at pre-

test was more than .05, we accepted the null hypothesis for the assumption of group's variance and concluded that there is no significant difference between treatment and control group.

Table 2.5

Mann-Whitney U test for Comparing the Means at Pretest for Treatment and Control Group to Test Homogeneity on Teachers' Perceptions of and Motivation on Effective Teaching Practices and Multiplicative Reasoning

Variable	Treatment group			Control group			z	p
	n	M	SD	n	M	SD		
Pretest	3	1.67	0.57	3	1.33	1.52	-.44	.65

Note. Indicator 3 in each question is reverse coded.

1- strongly disagree, 2- disagree, 3- somewhat disagree, 4- neither agree nor disagree, 5- somewhat agree, 6- agree, 7- strongly agree.

Table 2.6 present the result of Wilcoxon test on *perceptions of and motivation on effective teaching practices and multiplicative reasoning* for treatment group and control group. For treatment group, the result showed that there was no significant difference in the pre- and posttest, $z = -1.34$, $p = 0.18$. For control group, the result showed that there was no significant difference in the pre- and posttest, $z = -1.06$, $p = 0.28$.

Table 2.6

Wilcoxon test on Teachers' Perceptions of and Motivation on Effective Teaching Practices and Multiplicative Reasoning for Comparing the Means at Pre- and Posttest for Treatment and Control Group

Group	Pretest			Posttest			z	p
	n	M	SD	n	M	SD		

Treatment group	3	6.00	0.28	3	5.93	0.31	-1.34	0.18
Control group	3	5.40	0.72	3	4.77	0.50	-1.06	0.28

Note. Indicator 3 in each question is reverse coded.

1- strongly disagree, 2- disagree, 3- somewhat disagree, 4- neither agree nor disagree, 5- somewhat agree, 6- agree, 7- strongly agree.

APPENDICES

Jacobson, E., & Izsak, A. (2010). *Integrated Knowledge and Motivation Assessment: Multiplicative reasoning*. The University of Indiana.