Abstract Title Page

Title: A Randomized Controlled Trial of the Impact of the Fusion Reading Intervention on Reading Achievement and Motivation for Adolescent Struggling Readers

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Abstract Body

Background / Context:

The need for schools to focus on literacy during the adolescent grades is greater than ever. In 2011, 66% of fourth-grade and 70% of eighth-grade students were reading below proficiency on the National Assessment of Education Progress (NAEP) (National Center for Education Statistics, 2011). As many as one-third of fourth-grade students and nearly a quarter (24%) of eighth-grade students were reading even below the basic level. Low levels of literacy, as demonstrated by the NAEP, are alarming given the demands of school and the workforce.

Although significant research has been conducted to understand and contribute to reading practice in the early grades (e.g., Reading First, No Child Left Behind), similar research investments have not been made with struggling adolescents in secondary settings. In response, Congress authorized funding for Striving Readers in 2006 and in 2009 through discretionary grants administered by the U.S. Department of Education. The Striving Readers initiative was intended to increase adolescent literacy levels in Title I-eligible schools and to build a strong, scientific research base for identifying and replicating strategies that improve adolescent literacy skills. Fusion reading is one of the eight projects funded by Striving Readers in 2009.

Strategy-based interventions aim to teach students procedures or steps for solving problems while reading and understanding text (e.g., identifying unfamiliar words, decoding words) (Mayer, 1987). Strategies may be cognitive in nature (e.g., paraphrasing, questioning), metacognitive (e.g., comprehension monitoring), or behavioral (e.g., using a dictionary to look up words) (Almasi, 2003). Over the last few decades there has been a noticeable movement away from single-strategy approaches (Pressley, Harris, & Marks, 1992) and a movement toward using multiple-strategy interventions. Often these multistrategy interventions build on single-strategy interventions by combining strategy instruction and taking a more flexible approach to teaching (Gersten et al., 2001). Edmonds et al (2009) and Scammacca et als (2007) meta-analyses suggest that for adolescents, the most effective interventions are ones that target multiple areas of reading and aim to improve reading skills through the use of multiple strategies. It is likely that targeting one particular reading outcome and/or instruction in one reading strategy might be useful for some struggling readers; however, employing multistrategy interventions that target multiple reading outcomes may be more practical.

This study estimates the effect of one year of Fusion Reading implementation, a multistrategy intervention, builds on the work of the Strategic Instruction Model's Learning Strategies Curriculum and Xtreme Reading by integrating some of the same strategies (e.g., paraphrasing, visual imagery, and self-questioning for information acquisition; mnemonics for information study; and writing and error monitoring for information expression), focusing on reading, and extending the time frame from 1 to 2 years in duration.

Purpose / Objective / Research Question / Focus of Study:

The purpose of the current study is to evaluate the effectiveness of the Fusion Reading intervention after 1 year of implementation. Specifically, the study addressed the following:

1. What are the intent-to-treat impacts of the Fusion Reading intervention on the reading outcomes and motivation to read of struggling readers after receipt of 1 year of the intervention?
2. For which students are the interventions most and least effective?

3. In what ways are implementation factors associated with impacts (or lack of impacts) on reading and motivation outcomes?

Setting:

In the 2010–11 academic year, four middle schools and three high schools from three districts in the southeast and western suburban areas of Michigan participated in the Fusion Reading Intervention Study.

Population / Participants / Subjects:

Michigan State Department of Education (MSDE) recruited seven schools for this study by inviting schools based on district and school improvement goals, the school need to improve the reading skills of its students, and their willingness to participate in a randomized control study. The participating schools ranged in their enrollment from 400 to 1,400 students. The percentage of students eligible for free or reduced-price lunch ranged from 51% to 96%. The percentage of students reading below proficiency on the 2009 Michigan Educational Assessment Program (MEAP) reading test ranged from 26% to 61%, with an average of 42%.

Eligible students are those who: (1) scored between the 5th to 35th percentiles on the Test of Silent Contextual Reading Fluency (TOSCRF), (2) were not identified as a student with a severe cognitive disability, (3) were not Level-1 English language learners (ELLs), and (4) did not recieve any other reading interventions as required by their IEP. Of the 2,109 students were screened, 871 students were found to be eligible for the study (41.2%).

Blocking on schools and grade level, we randomized eligible students with parent consent in grades 6 through 10 to either the intervention or control condition. Students in the intervention condition received the Fusion Reading intervention as a supplemental reading intervention in the 2010-11 school year, whereas students in the control condition engaged in nonliteracy, "business-as-usual" activities. Both Fusion and control students participated in regular English language arts (ELA) classes at their school.

Intervention / Program / Practice:

Fusion Reading is a supplemental reading intervention designed for middle and high school students who score at least 2 years below grade level on standardized reading measures. It builds on the work of the Strategic Instruction Model's Learning Strategies Curriculum and Xtreme Reading by integrating some of the same strategies, focusing on reading, and extending the time frame from 1 to 2 years in duration. Struggling students are enrolled in the supplemental intervention for one class period for 5 days a week. The developers (Brasseur, Hock, & Deshler, 2010a, 2010b, 2010c; Hock, Brasseur, & Deshler, 2010a, 2010b, 2010c, 2010d, 2010e) recommend no more than 15 students per class. Fusion is a structured intervention with a specific curricular scope and sequence of high-leverage reading strategies within a framework focused on explicit comprehension, vocabulary, and motivation strategies, with teachers providing scaffold instruction, practice, feedback, and monitoring progress with ongoing formative assessments. Fusion is a fully developed instructional package. That is, all Fusion materials (seven teacher manuals and three student workbooks) have been produced and are off-the-shelf ready for full-scale implementation. The 2-year scope and sequence, instructional routines, and materials are described below. Please see the logic model of the intervention in Figure 1.

Research Design:

We conducted a randomized controlled trial to estimate the effect of Fusion Reading on struggling readers in grades 6 through 10. Students in the intervention condition received the Fusion Reading intervention as a supplemental reading intervention in the 2010-11 school year, whereas students in the control condition engaged in nonliteracy, "business-as-usual" activities. This paper reports the effect of the first year of reading intervention.

Data Collection and Analysis:

Intent-to-treat analysis (ITT). ITT is the average effect of the treatment based on the initial treatment assignment regardless how many participants actually received the treatment. The ITT analyses present the impact of assignment of Fusion instead of the impact of Fusion on students who received to Fusion. The ITT impact estimate is the expected effect of Fusion when it was implemented in the real world, with less than perfect teacher implementation and student dosage. Hierarchical linear modeling (HLM) was performed to take into account of students nested in schools. The dependent variables were reading achievement measures [TOWRE Sight Word Efficiency (SWE) and Phonetic Decoding Efficiency (PDE) subtests; The Group Reading Assessment and Diagnostic Evaluation (GRADE) passage comprehension, sentence comprehension, and vocabulary subtests; and Michigan's MEAP reading achievement] and reading motivation [the Children's Academic Intrinsic Motivation Inventory (CAIMI)]. The independent variables included a constant, pretest scores, demographic characteristics, and treatment indicator.

Treatment-on-the-treated analysis (TOT). Although the ITT analyses suggest the average effect of an intervention, it does not tell us the effect of the intervention for those students who actually received the intervention. This study used two approaches to estimate the effect of treatment on the treated. The first is the instrumental variable approach. Because random assignment is correlated with the fidelity of implementation measures (since control students have a value of zero for each implementation measure) but uncorrelated with the error term in the outcome equations, the treatment assignment indicator variable works as an instrument to represent fidelity of implementation (Gennetian, Morris, Bos, & Bloom, 2005). A two-stage, least-square model was executed to estimate the TOT.

The second approach used propensity score methods to select comparison students for the high student dosage group and for the low student dosage group. The logic of the propensity score methods was to select control students that, based on baseline measures of pretest scores, reading motivation, and demographic characteristics, would have had a similar chance of attending Fusion classes 80% or more of the time, but did not (Unlu et al., 2010). The same analyses were also conducted for the low student dosage group (< 80%) and their matched comparison students on all outcomes.

Findings / Results:

Fusion group attrition rate is 24%, control group attrition rate is 25%, and the differential attrition rate is 1%. Please see the attrition flow chart in Figure 2. Table 1 presents the student background characteristics and baseline equivalence test results of the participants in the intervention and comparison groups. HLM and Chi-square tests indicated that Fusion participants were not significantly different from control students on demographics or baseline

reading measures; however, control students had higher CAIMI reading scores than Fusion students at baseline (t = -1.89, p = .059).

The ITT analyses results (in Table 2) show that the Fusion Reading intervention was successful in improving sight word efficiency and sentence comprehension skills of students who were randomly assigned to receive Fusion classes as compared with those who were assigned to control condition. Fusion students had significantly higher TOWRE SWE ($p < 0.05$, effect size = 0.10) and GRADE sentence comprehension ($p < .05$, effect size = 0.15) at posttest than comparison group students. The effect of Fusion on the TOWRE SWE is the only outcome that remains significant after Benjamini-Hochberg correction (Benjamini & Hochberg, 1995). No other student outcomes were found to have a statistically significant effect. Table 3 shows the impact of Fusion for each grade on each student outcome.

Table 4 documents Fusion teachers' curriculum coverage and Fusion students' dosage rate. Table 5 presents the TOT results. For the instrumental variable TOT approach, we found that Fusion students whose teachers covered more Fusion curriculum achieved higher scores on TOWRE SWE ($p < .05$, effect size = 0.001) and GRADE sentence comprehension ($p < .05$, effect size = 0.002) than students whose teachers covered less Fusion curriculum. Our results also suggested statistically significant effects of students' Fusion dosage rate on GRADE sentence comprehension. The results using propensity scoring methods to select control students who were similar to students in the high Fusion dosage group indicated a 0.11 standard deviation improvement on TOWRE SWE ($p < .05$, effect size = 0.11, improvement index = 4). As compared with similar students in the control condition, students with less than an 80% dosage rate showed a 0.08 standard deviation increase in TOWRE SWE ($p < .05$, effect size = 0.08, improvement index = 3). Beyond the ITT effects of Fusion Reading intervention, the instrumental variable approach and propensity scoring approach both suggested a substantial mediating effect of student Fusion dosage rate and TOWRE SWE. The results of TOT and ITT results are confirmatory, as both indicated a strong effect of Fusion on improving students' sight word efficiency skills.

Conclusions:

Stronger research designs with standardized measures typically yield more reliable estimates of a treatments effect and may have greater value for informing practice than less rigorous designs. The Fusion Reading intervention was engineered from an understanding 1) on how adolescents who struggle learn to read (Gough & Tunmer, 1986); and 2) strategy intervention research with findings of a moderate to small effect sizes and best practices for improving adolescent reading outcomes (Kamil et al., 2008; Scammacca et al., 2009; Slavin Cheung, Groff & Lake, 2008). After one year of implementation of a two year intervention, we learned that when vocabulary, paraphrasing and word study strategies are explicitly taught by following a specific instructional routine supported by motivation strategies (e.g., setting goals and reading text relevant for the age group), word reading outcomes will significantly improve compared to control middle and high school students. Future research is needed to fully understand whether the intended two year intervention will improve struggling adolescent's reading comprehension outcomes.

Appendix A. References

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Appendix B. Tables and Figures
Not included in page count.

Table 1
Baseline Equivalence Tests of Fusion and Control Students on Demographic, Reading Achievement, and Reading Motivation for the Analytic Sample

	Treatment		Control		χ^2 or *t*	*p*
Variable	*M (SD)* or *%*	*N*	*M (SD)* or *%*	*N*		
Male	53.71	152	56.55	164	0.47	0.494
African American	81.27	230	80.34	233	0.08	0.778
Hispanic/Latino	7.07	20	6.21	18	0.17	0.679
White	10.25	29	12.07	35	0.48	0.489
Learning Disabilities	12.37	35	13.79	40	0.26	0.613
Any Disability	9.19	26	8.97	26	0.009	0.926
TOWRE SWE	89.63 (9.50)	279	89.73 (9.90)	290	0.21	0.836
TOWRE PDE	84.54 (14.17)	279	84.84 (14.78)	290	0.21	0.835
GRADE Passage Comprehension	10.33 (4.25)	278	10.54 (4.73)	284	-0.23	0.530
GRADE Vocabulary	88.29 (11.22)	281	87.41 (12.31)	287	1.07	0.287
MEAP Reading	-0.87 (0.67)	117	-0.88 (0.70)	135	0.11	0.913
CAIMI Reading	48.01 (11.13)	267	49.57 (11.04)	275	-1.89	0.059

Note. Standard deviations for continuous variables are in parentheses.

Table 2

Overall Intent-To-Treat Impact Analysis of Fusion on Student Reading Achievement

Outcome Measures	Treatment			Control			Estimated Impact	*Effect Size*	Improvement Index	*p*
	Model-Adjusted M	*SD*	*N*	*M*	*SD*	*N*				
TOWRE SWE										
Model A	90.16	9.64	279	89.06	10.50	290	1.10	0.11	4.38	0.022
Model B	90.17	9.64	279	89.06	10.50	290	1.11	0.11	4.38	0.021
Model C	90.06	9.63	283	89.04	10.46	297	1.02	0.10	3.98	0.035
Model D	90.07	9.63	283	89.04	10.46	297	1.03	0.10	3.98	0.033
TOWRE PDE										
Model A	85.33	14.18	279	85.26	14.23	290	0.07	0.005	0.20	0.909
Model B	85.34	14.18	279	85.26	14.23	290	0.08	0.006	0.24	0.893
Model C	85.27	14.16	283	85.21	14.16	297	0.06	0.004	0.16	0.927
Model D	85.28	14.16	283	85.21	14.16	297	0.07	0.005	0.20	0.915
GRADE Sentence Comprehension										
Model A	7.74	3.83	277	7.26	3.65	284	0.48	0.13	5.17	0.078
Model B	7.75	3.83	277	7.26	3.65	284	0.51	0.14	5.57	0.061
Model C	7.72	3.81	285	7.21	3.63	296	0.51	0.14	5.57	0.055
Model D	7.75	3.81	285	7.21	3.63	296	0.54	0.15	5.96	0.043
GRADE Passage Comprehension										
Model A	11.62	5.18	278	11.56	4.96	284	0.06	0.01	0.40	0.865
Model B	11.61	5.18	278	11.56	4.96	284	0.05	0.01	0.40	0.904
Model C	11.63	5.13	286	11.56	5.05	296	0.07	0.01	0.40	0.851
Model D	11.61	5.13	286	11.56	5.05	296	0.05	0.01	0.40	0.901
GRADE Vocabulary										
Model A	89.19	10.76	281	88.98	11.36	287	0.21	0.02	0.80	0.777
Model B	89.17	10.76	281	88.98	11.36	287	0.19	0.02	0.80	0.795
Model C	89.05	10.78	287	89.12	11.30	296	-0.07	-0.006	-0.24	0.928
Model D	89.02	10.78	287	89.12	11.30	296	-0.10	-0.009	-0.36	0.892
MEAP Reading										

Model A	-0.72	0.70	117	-0.78	0.72	135	0.06	0.08	3.19	0.359
Model B	-0.71	0.70	117	-0.78	0.72	135	0.07	0.10	3.98	0.300
Model C	-0.73	0.69	118	-0.80	0.74	138	0.07	0.09	3.59	0.299
Model D	-0.72	0.69	118	-0.80	0.74	138	0.08	0.11	4.38	0.243
CAIMI Reading										
Model A	49.08	10.85	267	48.96	11.24	275	0.12	0.01	0.40	0.880
Model B	48.98	10.85	267	48.96	11.24	275	0.02	0.002	0.08	0.983
Model C	49.05	10.78	273	48.82	11.33	283	0.23	0.02	0.80	0.777
Model D	48.98	10.78	273	48.82	11.33	283	0.16	0.01	0.40	0.840

Note. There were no missing data on demographic variables. Estimated impact is the coefficient associated with Fusion treatment variable from the HLM model; Effect size = Estimated impact/SD of the control group; Model adjusted treatment group mean = Estimated impact + Mean of the control group; Model A= HLM impact models controlling for pretest without imputation for missing pretests; Model B = HLM impact model controlling for pretest and demographic variables without imputation for missing pretests; Model C = HLM impact model using the dummy variable adjustment approach for imputing missing pretest scores (Puma, Robert, Stephen, & Cristofer, 2009). This approach sets the missing pretest scores to a constant and adds a dummy variable to indicate missing in the impact model. Model D = HLM impact model using imputed pretest scores and control for pretest and demographic variables.

Table 3

Intent-to-Treat Effect Size of Fusion on Student Outcomes Across Grade Levels

Grade Levels	TOWRE SWE	TOWRE PDE	GRADE Sentence Comprehension	GRADE Passage Comprehension	GRADE Vocabulary	MEAP Reading	CAIMI Reading
6th grade	0.17*	0.08	-0.02	-0.11	-0.05	0.15†	0.05
Treatment N/Control N	96/98	96/98	93/92	93/92	95/96	74/79	95/97
7th grade	-0.03	0.06	0.17	0.06	0.02	-0.07	-0.09
Treatment N/Control N	45/63	45/63	44/63	44/63	44/62	43/56	43/62
8th grade	0.05	0.05	0.72†	0.20	0.24	-	-0.37
Treatment N/Control N	12/19	12/19	12/19	12/19	12/19		11/18
9th grade	0.06	-0.20*	0.06	0.08	-0.001	-	0.34*
Treatment N/Control N	79/60	79/60	81/60	82/60	83/60		73/50
10th grade	0.08	0.12	0.31	-0.03	0.01	-	-0.14
Treatment N/Control N	47/50	47/50	47/50	47/50	47/50		45/48

†$p < 0.10$, ∗$p < .05$. ∗∗$p < .01$. ∗∗∗$p < .001$.

Table 4

Description of Fusion Reading Fidelity of Implementation Measures for Fusion Students in the Analysis Sample

Variables	*Mean (%)*	*SD*	*N*
Teacher Level			
Curriculum Coverage	73.00	18.65	9
Proportion of Teachers with 80%+ Curriculum Coverage	33.00	49.24	9
Student Level			
Fusion dosage rate	72.69	28.31	241
Proportion of Students with 80%+ Dosage	57.26	49.58	241

Table 5

Treatment-on-the-Treated Effect of Fusion on Student Outcomes

Method	Variables	TOWRE SWE	TOWRE PDE	GRADE Sentence Comprehension	GRADE Passage Comprehension	GRADE Vocabulary	CAIMI Reading
IV	Curriculum	0.01*	0.0007	0.008*	0.002	0.0008	0.004
	Coverage Rate	(0.007)	(0.009)	(0.004)	(0.005)	(0.01)	(0.01)
	Effect Size	0.001	0.00005	0.002	0.0004	0.00007	0.0004
	R^2	0.96	0.73	0.30	0.27	0.40	0.33
	Fusion Dosage	0.01	-0.007	0.008*	0.002	-0.002	0.009
	Rate	(0.007)	(0.009)	(0.004)	(0.005)	(0.01)	(0.01)
	Effect Size	0.001	-0.00005	0.002	0.0004	-0.0002	0.0008
	R^2	0.69	0.74	0.32	0.27	0.39	0.34
	80%+Dosage	1.31	-0.92	1.06*	0.28	-0.28	1.13
		(0.88)	(1.16)	(0.49)	(0.68)	(1.37)	(1.40)
	Effect Size	0.12	-0.06	0.29	0.06	-0.02	0.10
	R^2	0.69	0.74	0.31	0.27	0.39	0.34
PS	High Dosage	1.11*	-0.56	0.47	-0.35	-0.23	0.33
	(80%+dosage)	(0.44)	(0.88)	(0.33)	(0.43)	(0.69)	(0.74)
	Effect Size	0.11	-0.04	0.13	0.07	0.02	0.03
	Low Dosage	0.84†	-0.71	0.34	0.19	-0.04	0.27
	(80% - Dosage)	(0.49)	(0.55)	(0.49)	(0.40)	(0.61)	(1.58)
	Effect Size	0.08	-0.05	0.09	0.04	-0.004	0.02

Note. IV = instrumental variable approach; PS = propensity score methods. For the IV model, all first stage F statistics were statistically significant at the 0.001 level. Coefficients and robust standard errors (in parentheses) are presented. All the models controlled for pretest, gender, race, grade level, and disability.

†p< 0.10, *p < .05. **p < .01. ***p < .001.

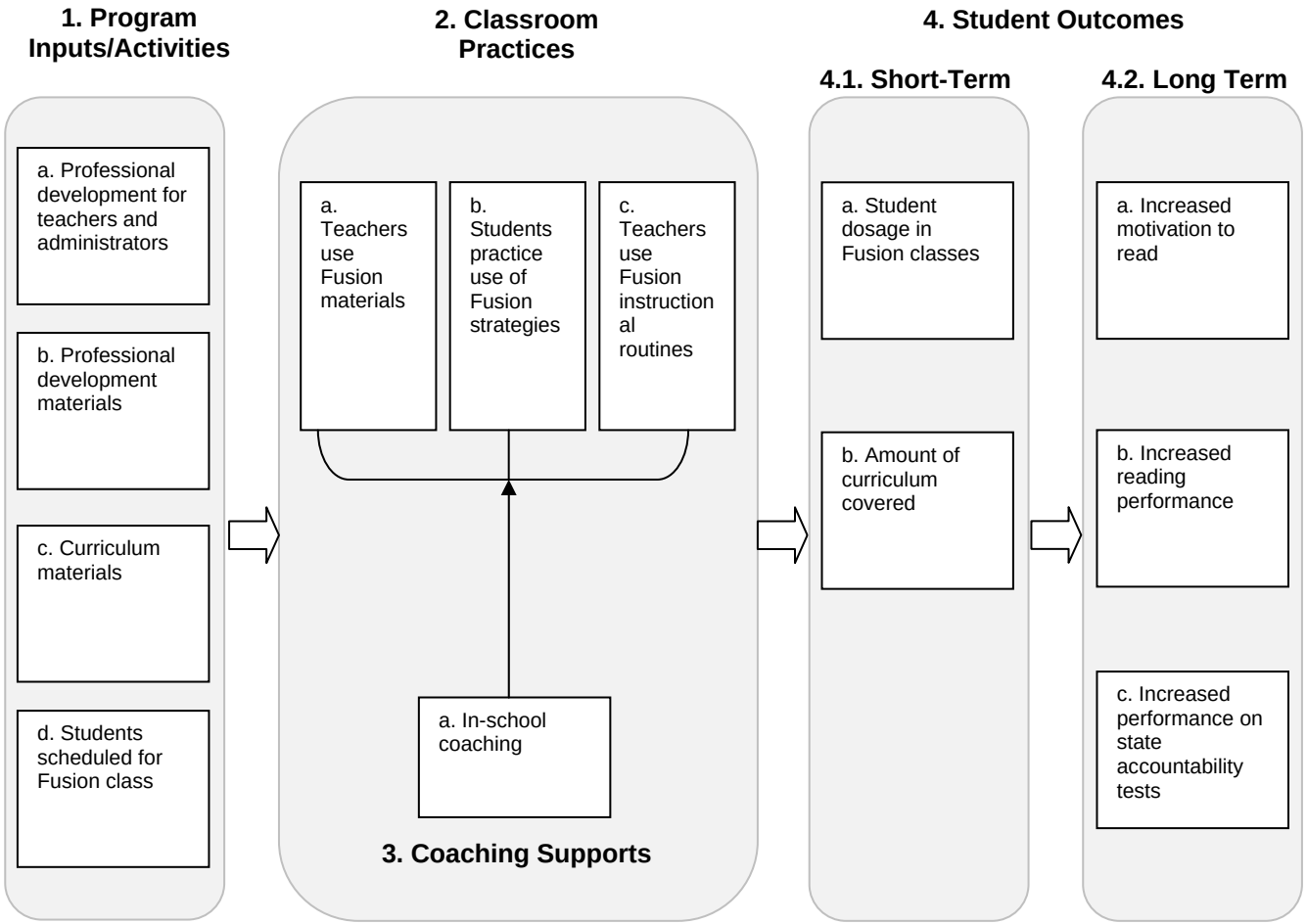

Figure 1. Logic model for Fusion Reading Intervention

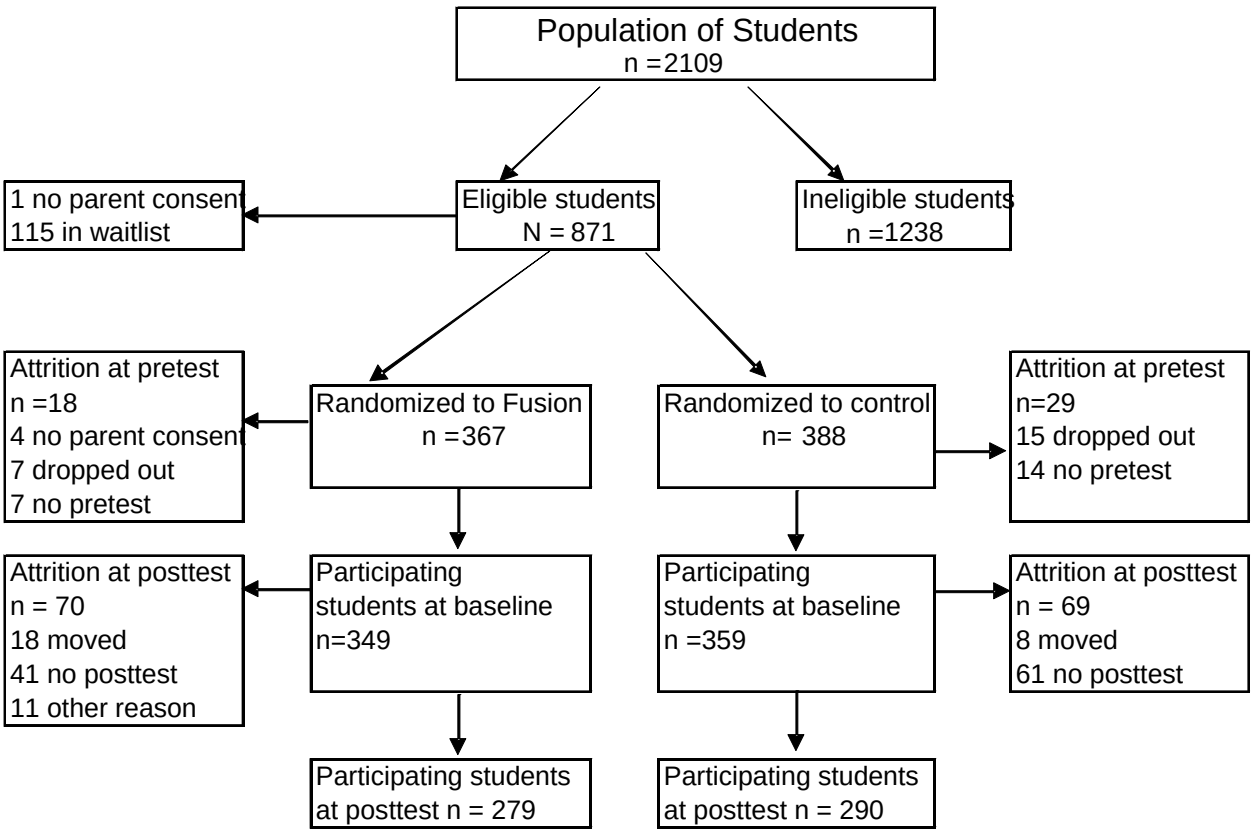

Figure 2. Overview of the flow of research participants through screening, randomization, consent procedures, and data collection of the Fusion Reading Intervention randomized controlled trial.