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First graders' literacy and self-regulation gains: The effect of individualizing student instruction

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Abstract

We examined the effect of individualizing student instruction (ISI; *N*=445 students, 46 classrooms) on first graders' self-regulation gains compared to a business-as-usual control group. Self-regulation, conceptualized as a constellation of executive skills, was positively associated with academic development. We hypothesized that the ISI intervention's emphasis on teacher planning and organization, classroom management, and the opportunity for students to work independently and in small groups would promote students' self-regulation. We found no main effect of ISI on self-regulation gains. However, for students with weaker initial self-regulation, ISI was associated with greater self-regulation gains compared to peers in control classrooms. The ISI effect on self-regulation was greater when the intervention was more fully implemented.

Keywords

Self-regulation; Executive functioning; Individualizing instruction; Intervention; Reading comprehension; Vocabulary; Social–emotional assessment; Elementary children; Academic intervention

1. Introduction

Too many students do not acquire the basic literacy skills they need to succeed in school. Indeed, over 30% of students fail to achieve basic reading proficiency by fourth grade and this percentage is higher (over 55%) for those who attend high-poverty schools (National Assessment of Educational Progress [NAEP], 2007). Evidence suggests that, in addition to early literacy skills, individual differences in students' self-regulatory skills contribute to differences in academic achievement (Smith, Borkowski, & Whitman, 2008). Self-regulation underlies multiple skill domains related to controlling and directing behavior, and enables students to function in cognitively challenging settings, such as first grade. Both literacy and self-regulatory competence appear to be associated with teacher practices, such as planning, organizing, and managing the classroom (Cameron, Connor, Morrison, & Jewkes, 2008; McClelland et al., 2007; Ponitz et al., 2008). There is strong accumulating causal evidence that teachers' practices contribute to students' literacy growth (National Reading Panel [NRP],

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2000), but this is not the case for self-regulation, where the evidence is largely correlational. The purpose of this study was to examine whether an intervention designed to support teachers' planning, classroom management, and individualizing student instruction might contribute to fall-to-spring growth in students' self-regulation, compared to a randomized control condition.

1.1. Student self-regulation in the classroom

Effective teachers may promote literacy skills, in part, through encouraging their students to develop self-regulation (Paris & Paris, 2001; Pressley et al., 2001). Self-regulation is defined as the deliberate modulation of one's responses to stimuli and includes how an individual functions in the face of different types of activation (e.g., attentional, behavioral, or emotional activation; Baumeister & Vohs, 2004; Calkins, 2007). As generally defined, *self-regulation* includes a specific constellation of skills critical for persisting on academic tasks and completing work independently (Blair & Razza, 2007; Deater-Deckard, Petrill, Thompson, & DeThorne, 2006; McClelland, Acock, & Morrison, 2006; McClelland et al., 2007). Students with stronger levels of overall self-regulation, measured with tasks that necessitate integrating multiple component skills, specifically attention, working memory, and inhibitory control, generally achieve at higher levels compared to students with weaker overall self-regulation (Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003; McClelland et al., 2007; Ponitz, McClelland, Matthews, & Morrison, 2009).

For this study, the working model of the mechanism by which greater self-regulation would support increased growth in academic literacy skills builds on this conceptualization of self-regulation as the capacity to modulate attention and behavior in response to contextual contingencies (see Fig. 1). In particular, students with stronger self-regulatory ability might be better able to focus cognitive resources (e.g., sustained and flexible attention, working memory) on the learning task at hand (e.g., listening to teacher instructions, reading text, completing a writing activity). Compared to poorly regulated peers, a student with stronger self-regulation might be more likely to ignore distractions posed by other students and unrelated classroom stimuli. Further, in the context of a classroom where students are expected to manage their own attention (e.g., in independent learning centers, in transitions between and during small and larger group instructional episodes), students with better self-regulation also may be likely to maximize their learning time throughout the day. Theoretically, this capability to mobilize and maintain cognitive attention and engagement would lead these students to experience more, or at least more efficient, time-on-task with the literacy activities made available to them within the classroom. This efficiency could ultimately lead to more efficient learning of the literacy skill competencies. Key to this model is the assumption that specific teacher practices (planning, classroom management, use of routines, and providing opportunities for students to work independently and with peers) would tend to support the development of stronger self-regulation and, hence, stronger academic skills, such as literacy.

1.2. Child-by-instruction interactions and individualizing student instruction

Studies reveal that the impact of specific literacy instruction strategies depends on students' vocabulary and reading skills (Connor, Morrison, Fishman, Schatschneider, & Underwood, 2007; Connor et al., 2009). These robust child-by-instruction interactions are evident from preschool through third grade across different studies and samples and on a number of student outcomes including vocabulary and literacy skills (Connor, Morrison, & Petrella, 2004; Connor, Morrison, & Slominski, 2006; Connor et al., 2007a; Juel & Minden-Cupp, 2000). Interventions designed to take into account students' individual differences may enhance the skill a particular student needs to acquire by providing learning experiences that specifically target that skill, owing to the assumption that not all students develop or learn in the same way (Bronfenbrenner & Morris, 2006). For example, in two randomized control studies, students in treatment classrooms where teachers individualized students' literacy instruction (ISI intervention) using small groups made significantly greater gains (about a 2 month advantage on average) in reading compared to students in control classrooms (Connor, Morrison, et al., 2009; Connor, Piasta, et al., 2009). The ISI intervention required teachers to implement differentiated literacy instruction recommendations based on individual students' vocabulary and reading skills. To support teachers' skills in implementing the intervention with fidelity, professional development focused explicitly on key organizational strategies. The ISI intervention was designed to reinforce these strategies, shown in the process–product literature to improve student outcomes, including behavior (Brophy, 1979; Domitrovich, Cortes, & Greenberg, 2007). These strategies include organizing, minimizing non-instructional time, and planning.

1.2.1. Organizing—Organizing is comprised of explaining the purpose of activities, describing upcoming activities, and providing explicitly scaffolded opportunities for students to rehearse task-related behaviors (Brophy, 1979, 1983; Pressley et al., 2001). Further, observational studies suggest that higher levels of teacher organizing are associated with stronger classroom management and that strong management predicts time spent in independent activities as well as reading achievement (Brophy, 1983; Cameron et al., 2008). The ISI intervention amplifies and enhances teacher organizing in multiple ways. For example, professional development and training materials emphasize organizing activities as a way to enhance student learning and classroom functioning, especially during center or small group time.

1.2.2. Non-instructional time—Students in classrooms where more time is spent organizing for activities tend to spend less time in non-instructional activities, such as transition (Cameron et al., 2008). These findings accompany evidence that the more time students spend in non-instructional activities, including waiting for teachers to begin lessons, standing in line, and experiencing disruptions, the less time they spend in instruction and the weaker their achievement (Arlin, 1979; Cameron, Connor, & Morrison, 2005; Cameron et al., 2008).

1.2.3. Teacher planning—Existing research, although surprisingly limited, also generally supports the importance of teacher planning. Teachers who effectively establish and implement rules and routines are less likely to experience difficulties with classroom management (Borko & Niles, 1987; Epsten, Atkins, Cullinan, Kutash, & Weaver, 2008). Teachers who plan to differentiate instruction in order to meet the instructional needs of special students in their classroom tend to be more effective overall (Fuchs, Fuch, & Phillips, 1994), and there is some evidence that planning might build teacher expertise (Dunn & Shriner, 1999). An integral part of the ISI Intervention, the Assessment-to-instruction (A2i) web-based software (http://isi.fcrr.org), was designed to help teachers plan instruction for each student (Connor, in press; Connor, Morrison, Fishman & Schatschneider, 2010). Based on A2i teacher use logs, the more teachers used A2i software overall, the more time they spent using the planning-specific aspects of A2i (i.e., the Literacy Minutes Manager and the Group Activity Planner). Thus, A2i use represents a proximal measure of the time teachers spent planning as well as teacher fidelity to the ISI intervention.

We hypothesized that students in ISI intervention classrooms would demonstrate greater self-regulation gains, compared to students in control classrooms. We also predicted that the impact of ISI on students' self-regulation would increase as fidelity of implementation increased. We expected that implementing ISI would promote students' self-regulation through multiple avenues (see Fig. 1), based on research demonstrating that adults support students' self-regulation skills through creating an organized environment, providing opportunities for them to practice managing their own behavior, and minimizing chaos and distractions.

The following two research questions guided this inquiry. The first question was, Do teachers in the ISI group demonstrate stronger classroom management skills than do teachers in the control group? Stronger classroom management is defined as more time spent in instruction, more time in small groups, less time in disruptions, and less time in discipline activities and non-productive transitions (e.g., waiting for the teacher and waiting in line). We included this question to help corroborate our hypothesis that teachers' classroom practices contribute to students' potential self-regulation growth. Thus, we hypothesized that compared to control group students, treatment group students would generally spend more time in instruction, more time in small groups, less time in disruptions, and less time in discipline activities. Additionally, a positive association between A2i use – because it represents teacher planning and is a proxy for teacher fidelity to the intervention – and student's self-regulation would help to confirm our hypothesis that the specific classroom practices encouraged by the ISI intervention were associated with growth in self-regulation. The second question was, What is the effect of the ISI intervention on students' self-regulation growth? We hypothesized that students in ISI classrooms would demonstrate greater gains in self-regulation than those in the control classrooms. Moreover, we anticipated that the effect of the ISI intervention on students' self-regulation would increase when teachers used A2i more frequently.

2. Method

2.1. Participants and settings

The final sample size for the present investigation was 46 teachers and 445 first grade students in 10 schools in a mid-sized southern city. Descriptive information for the classroom and teachers ($n = 22$ intervention and 24 control) are provided in Tables 1 and 2. The district, located in North Florida, is large and includes rural, urban, and suburban communities. Of the 10 participating elementary schools, two were rural, four were urban, and four were suburban. In four of the schools, 82% or more of the students qualified for free and reduced lunch. Both treatment and control group teachers taught literacy using one of two core reading curricula (i.e., Open Court [$n = 8$ schools: 4 treatment and 4 control] and Reading Mastery [$n = 2$ schools: 1 treatment, 1 control]) during a 120-minute block of time dedicated to literacy instruction. In this cluster randomized control field trial, schools were matched and paired on three variables: state achievement test results, the percentage of students qualifying for free or reduced price lunch, and Reading First status (a federal initiative to provide funding to historically underperforming or high-poverty schools). One school from each matched pair was randomly assigned to the ISI condition, and the other was randomly assigned to a waitlist control condition.

A total of 49 first grade teachers (out of 53 invited from the participating schools) volunteered to participate in the study. One treatment teacher was excused because he taught second graders during the 120-minute literacy block. One control teacher was not included in these analyses because he was teaching a special education class, and one control teacher discontinued participating in the study for personal reasons. All teachers were the student's classroom teacher and provided literacy instruction during the observed literacy time block.

The sample of students was highly diverse. Forty-seven percent of the students were African American (n=98 treatment, 111 control), 35% were Caucasian (55 treatment, 101 control), 18% were other ethnicities (16 treatment, 64 control) including Hispanic and Asian. Forty-nine percent were boys (218 treatment, 227 control).

2.2. Measures

2.2.1. Individual student-level variables

2.2.1.1. Student achievement: We used Form A and Form B of the Letter–Word Identification, Passage Comprehension, and Picture Vocabulary tests of the Woodcock-Johnson III Tests of Achievement (WJ III; Woodcock, McGrew, & Mather, 2001) to assess students' reading and vocabulary skills at pretest and posttest. Scores from these tests have demonstrated internal consistency reliability estimates ranging from .70 to .71 for Picture Vocabulary to .96 for Passage Comprehension and .97–.98 for Letter–Word Identification for students in first grade (ages 6–7 years). The WJ III Letter–Word Identification and Passage Comprehension tests were used as measures of overall reading skill. Letter–Word Identification asks students to recognize and identify letters and then read increasingly more difficult and complex words. Passage Comprehension uses a cloze procedure where students are asked to fill in the word missing from increasingly difficult sentences and passages. Students must be able to decode the passages while comprehending what they read well enough to select the appropriate word. The WJ III Picture Vocabulary task asks students to name pictures of increasingly more unfamiliar objects. Thus, it is a measure of expressive vocabulary. Students received either Form A or Form B, at random, in the fall and the opposite form in the spring; there were no form effects when means were compared. Descriptive statistics are provided in Table 2. W scores, which are a form of Rasch score, were used in all analyses. A W score of 500 (*SD*=15) represents the typical score of a 10-year-old student.

2.2.1.2. Self-regulation: We assessed participants' self-regulation using the Head-Toes-Knees-Shoulders (HTKS) task, an expanded version of the simpler Head-to-Toes task (Ponitz et al., 2008). The HTKS task requires students to attend to the examiner's directions, to remember multiple rules for behavior, and to control their dominant response while initiating a subdominant response, in the form of gross motor actions. Two forms (A and B) exist, and they have been shown to produce no significant difference in average scores with kindergarten students (Ponitz et al., 2009). The HTKS scores have shown evidence of concurrent validity with teacher reports of classroom behavioral regulation, including following directions and completing multi-step tasks, and with parent reports of inhibitory control and attention (Ponitz et al., 2009). Fall performance also predicts spring performance in academics, including literacy, in preschool and kindergarten, controlling for background variables and fall academic performance (McClelland et al., 2007; Ponitz et al., 2009).

In Form A of the HTKS, students were first habituated to “head” and “toes” and were told, “When I say touch your head, touch your head and when I say touch your toes, touch your toes.” Children were then given several prompts (e.g., “toes” or “head”). Once children learned the task, then examiners stated, “Now we are going to do something silly. When I say touch your head, I really want you to touch your toes and, when I say touch your toes, I want you to touch your head. Let's try.” After 3 practice items, students were administered items 1–10 using these two rules. Students then repeated the habituation task, this time with commands to touch their “shoulders” or “knees.” Then, they were told to do the opposite. After the practice items, items 11–20 were administered incorporating all four rules (e.g., touch your head if told to touch toes and touch your shoulders if told to touch knees). In Form B of the HTKS, students were first habituated to the “shoulders” and “knees” and then asked to switch commands in items 1–10. Then, “head” and “toes” switched were added (four rules in all) in items 11–20. Across both forms of the task, 2 points were given for a correct response, 1 point was given for an initially incorrect response that was spontaneously corrected (i.e., a self-correction), and 0 points were given for an incorrect response not corrected. Thus, for each form of the HTKS, students earned up to 40 points. Students were randomly administered either Form A or Form B in the fall and the opposite version in the spring. In this sample, at each time point, there was no significant difference in average scores between the two versions. Examiners achieved excellent inter-rater reliability when scoring videotapes of 20 different children, 10 per form, responding to the items (.95 for self-corrections, .98 overall).

To provide validity evidence for the HTKS scores with first-grade students, across both forms, we examined associations among teachers' reports of students' social skills and behavior problems using the Social Skills Rating System (SSRS; Gresham & Elliot, 1990) and fall and spring HTKS scores. The Social Skills scale of the SSRS assesses students' ability to follow rules, take initiative, and interact constructively with others. It has yielded alpha reliability coefficients of .93 for elementary-school-age girls and .94 for elementary-school-age boys. The Problem Behavior scale of the SSRS assesses externalizing, internalizing, and hyperactivity and asks questions about children's behavior in class, such as whether they fight with others, bully, appear lonely, and so on. It has yielded alpha reliability coefficients of .87 for girls and .88 for boys. We predicted that constructs captured by the HTKS should also predict students' social skills and behavior problems, as measured by the SSRS, to some extent. Teachers completed the SSRS once for each target student during the middle of the school year when, following the SSRS protocol, students had been in their classroom at least two months. Teacher forms were completed for 398 (88%) of the 445 students (n=174 in treatment classrooms and n=224 in control classrooms). Using SSRS standard scores provided by the test manual (M=100, SD=15), missing data analyses using MANOVA revealed no significant differences on HTKS or achievement measures between students with and without SSRS scores, Wilks' Lambda=.996, $F(8, 440)=.240$, $p=.983$ and no significant missing-score-by-treatment interaction, Wilks' Lambda=.972, $F(8, 438)=1.552$, $p=.137$.

Using hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002) to control for the nested structure of the data (i.e., children nested in classrooms), we examined associations (see Table 3) among fall and spring HTKS and the SSRS social skills and problem behavior scales. Overall, teachers' SSRS ratings were associated in the expected direction with students' scores on the HTKS. Higher scores on both the fall HTKS or the spring HTKS were associated with higher scores on the SSRS Social Skills scale and lower scores on the Problem Behavior scale. These associations remained similar, albeit somewhat weaker, when we controlled for students' fall vocabulary scores. We verified that the fall HTKS score predicted students' overall literacy skills (Phillips & Lonigan, 2005) using multivariate multilevel models (Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2004) with spring WJ III Picture Vocabulary, Letter–Word Identification, and Passage Comprehension W scores as the multiple dependent variables (level 1) with fall HTKS scores as the independent variable (classroom-mean centered), controlling for fall literacy skills (grand-mean centered) entered at level 2, nested in classrooms (level 3). Results are provided in Table 4. Overall, students who had lower fall HTKS scores demonstrated weaker literacy skill gains by spring for all three spring assessments than did children with higher fall HTKS scores. Taken together with previous research with preschoolers (McClelland et al., 2007) and kindergartners (Ponitz et al., 2009), these findings indicate that HTKS scores are associated with SSRS scores and that fall HTKS scores significantly predict literacy skill gains. These findings suggest that the HTKS assessment is consistent with the construct of self-regulation for first graders.

2.2.2. Classroom-level variables

2.2.2.1. Time using A2i: Teachers in the intervention group were taught to individualize student instruction using Assessment-to-instruction (A2i) planning software, which translates assessment results into specific recommendations for amounts and types of instruction for each student in the classroom (Connor, Morrison, Fishman, et al., 2007). The software automatically records teachers' use of the software, including the total number of minutes spent actively using it. These times (in minutes) were used as a metric of planning and a proxy for intervention fidelity, because the more time teachers spent using A2i, the more likely they were to individualize instruction in the classroom and the greater were their students' reading skill gains (Connor, Piasta, et al., 2009). Teachers used A2i software, on average, about 160 minutes from September through May, but this time ranged from 15 to 370 minutes with a normal distribution. To create the ISI Treatment variable, teachers in the control group were coded as 0, and teachers in the ISI treatment group were assigned the total number of minutes they used A2i from fall to spring. In this way, the A2i variable differentiated the treatment and control conditions.

2.2.2.2. Instruction and non-instruction variables: Using data from the classroom observation coding system described below, classroom instruction variables were computed. The variables represent the mean number of minutes each participating student was involved in instructional activities, organizing, and non-instruction, including transitions, disruptions and discipline (see Table 1) during the language arts block across all three observations. Detailed descriptions of each are provided in the Appendix A.

2.3. Procedures

All students attending the first-grade classrooms were recruited to participate. Consent was obtained for over 75% of the students (*n*=707). From this group, the sample for this study (*n*=445) was randomly selected. During the random selection process, students were first ranked by their fall W score on the WJ III Letter–Word Identification test. Then, students were selected at random — four from the top third readers of the class, four from the middle third, and four from the bottom third. In classrooms where consent was obtained for 12 or fewer students, all consented students in that classroom were included. Students were tested in the fall and spring by trained research assistants using alternate forms of the HTKS and the WJ III in a quiet hallway or room near their classroom.

2.4. Individualized student instruction (ISI): assessment-to-instruction (A2i) software and professional development

Professional development provided to treatment group teachers focused specifically on how to use the A2i software to plan instruction, individualize instruction using multiple small groups and meaningful independent seat work, select strategies on planning and classroom management, and facilitate transitions and maximize efficient use of instructional opportunities (Connor, Morrison, Fishman, et al., 2007; Connor, Piasta, et al., 2009). Training was also provided on using assessment to guide instruction and differentiating instruction by considering dimensions of instruction. Of note, the district required all teachers throughout the district to provide a dedicated block of time for language arts and reading instruction. Thus, the specific ISI manipulation was individualizing instruction following A2i software recommendations.

2.4.1. Classroom observations: instruction, organization, and non-instruction time—Classrooms were videotaped during the school year with one observation in the fall, one in the winter, and one in early spring — three in all. Observations were scheduled at the teacher's convenience and were conducted during the 120-minute block of time dedicated to literacy instruction. Videos were coded using the Noldus Observer Pro software (Noldus Information Technology, 2001). The coding system (Connor, Morrison, et al., 2009) was designed to assess the amount of time, in seconds, that each target student was involved in various activities during the 120-minute language arts block. Any activity lasting 15 seconds or longer was coded by trained research assistants. Reliability across coders was adequate to excellent (mean kappa=.78, range .50 to .92, Landis & Koch, 1977).

We computed the number of minutes each participating student was involved in instructional activities, organizing, and non-instruction, including transitions, disruptions and discipline (see Table 1) during the language arts block over all three observations. Detailed descriptions of each are provided in the Appendix A. To aggregate these student-level variables to create classroom instruction variables, we first ran HLM with repeated observations (i.e., using fall, winter, and spring data), centered at the winter observation, nested in students, nested in classrooms, which were used to compute the student-level empirical Bayes residuals for amounts of each type of activity. This step provided fitted winter mean activity amounts for each student that controlled for changes from fall to spring (i.e., slope). These variables were then aggregated at the classroom level (mean) and used as classroom-level variables for subsequent models. Instructional activities included all literacy activities as well as time spent in any other academic content areas, such as science, math, or social studies. The mean for each classroom was used in the models. Previous study observations revealed that treatment group teachers were significantly more likely to provide instruction in small groups and to provide A2i recommended amounts and types of instruction than were control teachers (Connor, Piasta, et al., 2009).

2.5. Research design

In this cluster randomized control field trial, teachers in the ISI schools were taught to use A2i software and received intensive professional development throughout the school year on how to individualize instruction, including using small groups and centers, planning, organization, and classroom management strategies, during the first year of the study (2005–2006). Teachers in the control schools received the intervention training throughout the following year (2006–2007) and thus represent a “business-as-usual” control for this study.

2.6. Analysis

2.6.1. Hierarchical linear models (HLM)—We used HLM (Raudenbush & Bryk, 2002) to accommodate the nested structure of our data—students nested in classrooms. Failing to account for shared classroom variance can lead to misestimation of standard errors. We built models systematically beginning with the unconditional model. From the unconditional model, we computed the intraclass correlation, which is the proportion of variance falling between classrooms. Variables that did not significantly contribute to the outcome were trimmed from the model to preserve parsimony. The percentage of variance explained was computed by comparing the variance in the final model with the variance in the unconditional model (i.e., by subtracting the final model variance from the unconditional model variance and dividing by the unconditional model variance, Raudenbush & Bryk, 2002).

We then added student gender, fall literacy scores (grand-mean centered) and fall HTKS scores, which were classroom-mean centered, at the individual child level (level 1). School-wide SES and the ISI intervention variable (A2i) were entered into the model at the classroom level (level 2). The A2i coefficient is interpreted as the mean difference between (a) teachers in the control group and (b) teachers in the treatment group who used the software for 1 minute above 0, which included all treatment group teachers. The least time spent using A2i was 15 minutes. To examine differences between control and treatment fitted mean student outcomes, we compared the intercept of the model (i.e., the fitted mean score for students in the control group) with the fitted mean score of treatment students as a function of A2i use in minutes (i.e., intercept student score=control student fitted score; intercept plus the A2i coefficient times minutes of A2i use=treatment student fitted score). We finally tested the cross-level interactions and trimmed any interactions that were not significant to preserve parsimony.

3. Results

Again, the research questions guiding this study were as follows: (a) do teachers in the ISI group demonstrate stronger classroom management skills than do teachers in the control group? and (b) what is the effect of the ISI intervention on students' self-regulation growth? First, we examined descriptive data and relations among our independent and dependent variables. There were no significant differences (with a Bonferroni-corrected level of $p \leq .008$) in students' fall scores, including HTKS scores, when we compared the performance of students in the treatment and control classrooms, with the exception of fall vocabulary. Students in the treatment classrooms, on average, had significantly weaker fall vocabulary scores than did those in the control classrooms (see Table 2).

Self-regulation, as measured by HTKS scores, was fairly stable from fall to spring (see Tables 2 & 3). Overall, students with higher fall scores also achieved higher spring scores (r=.32), and scores increased from fall to spring by about 3 points. Students with stronger self-regulation skills in the fall also tended to demonstrate higher fall vocabulary and reading scores (r=.21–.35). It is possible that performance on the HTKS, which is administered orally, might be strongly influenced by students' vocabulary and general linguistic skills. However, after controlling for fall vocabulary scores, associations among the fall and spring HTKS and other measures remained similar (see Table 3). When we examined correlations between self-regulation and student gender, there were no systematic differences; boys (coded 1) were no more or less likely to score well on the HTKS task than were girls (fall HLM coefficient=−.71, p=.282; spring HLM coefficient=−.41, p=.517).

In this sample, African American students were more likely and Caucasian students were less likely to attend high-poverty schools. Hence, relations among students' socio-demographic characteristics and task performance were considered at the school rather than the student level. Students in lower SES schools generally demonstrated weaker HTKS scores than did students who attended more affluent schools (see Table 5).

3.1. Treatment and control teacher differences in organization and classroom management

Teachers in the ISI intervention generally demonstrated stronger classroom management skills compared to teachers in the control group. Using Multivariate General Linear Modeling (MGLM, SPSS version 16), we first examined mean differences between treatment and control classrooms comparing literacy time spent in the following types of activities: instructional, including teacher/child-managed small groups, child/peer-managed small groups, students working independently; and procedural time that students spent in organizational activities, transitions, and disruptions, the amount of time students were off-task and time spent being disciplined. See Appendix A for descriptions of variables and Table 1 for means and standard deviations by treatment and control condition. Overall, treatment classroom teachers demonstrated better classroom management compared to control classroom teachers, Wilks Lambda=.77, $F(8, 453)=16.67$, $p<.001$. Post hoc analyses revealed that, on average, students in treatment classrooms spent significantly more time in instruction, more time in teacher/child-managed and child/peer-managed small groups, more time working independently, and less time in disruptions. When the types of transitions were compared (i.e., waiting, lining up, between activities, and cleaning up), students in treatment classrooms spent significantly more time in productive transitions (i.e., between activities and cleaning up; Treatment M=10 minutes; Control M=7 minutes) with no significant difference in time spent in non-productive transitions (i.e., waiting and lining up). Moreover, the more time that treatment group teachers spent using the A2i software, the less time students in their classroom spent in disruption and discipline events (see Table 6).

3.2. Effect of the ISI intervention and A2i use on students' self-regulation gains

In general, students in classrooms where teachers implemented the ISI intervention and used A2i to a greater extent (i.e., implemented the intervention with greater fidelity) generally showed greater gains in self-regulation (i.e., the residualized change, or the spring outcome holding fall score constant at the mean) compared to students in the control classrooms, but this effect depended on the amount of time over the school year that teachers used A2i. We modeled the effect of the ISI intervention on spring HTKS scores while controlling for student characteristics (see Table 7). Because we used a randomized control design, our intent was to increase power to demonstrate effects rather than to control potential assignment bias. The intraclass correlation for fall self-regulation was .07. The final model explained 13% of the variance in children's scores.

There was no main effect of ISI on students' self-regulation growth (see Table 7). That is, for students with typical self-regulation, whether they were in a treatment or control classroom, there was no significant effect on their HTKS score gains from fall to spring, controlling for initial fall literacy scores. However, for students with HTKS scores in the lowest quartile (obtaining fewer than 25 points out of 40), participating in the ISI intervention had a significant positive effect on their HTKS score gains compared to peers in control classrooms. As hypothesized, this effect depended on teachers' A2i use (see Fig. 2). The mean difference between groups increased as teachers' A2i use increased. For example, if we compare three children who all achieved scores of 5 on the HTKS task in the fall – one in a control classroom, one in a classroom where the teacher used A2i for 70 minutes, and another where the teacher used A2i for 285 minutes – they would attain fitted spring scores of approximately 26 in the control classroom, 27 in the classroom where the teacher used A2i for 70 minutes, and 31 in the classroom where the teacher used A2i for 285 minutes. These results translate to effect sizes (*d*) of .19 for the child whose teacher used A2i for 70 minutes and .96 for the child whose teacher used A2i for 285 minutes.

Fall vocabulary, letter–word reading, and passage comprehension scores did not significantly predict self-regulation growth. There was a trend toward a significant negative effect of school SES on spring HTKS (p=.058), indicating that students attending lower SES schools might be slightly less likely to show self-regulation gains compared to students attending higher SES schools, but the effect was negligible (d=.09 for a 1 *SD* difference in SES).

4. Discussion

The principal purpose of this study, which utilized a cluster randomized control design, was to investigate whether teachers' participation in and implementation of the ISI intervention was associated with first graders' gains in self-regulation, in addition to the previously reported effect on literacy skills (Connor, Morrison, Fishman, et al., 2007; Connor, Piasta, et al., 2009). We hypothesized that ISI would tend to support the development of students' self-regulation (see Fig. 1) because the teachers in the ISI intervention received explicit training in how to plan differentiated instruction using the A2i software and in classroom management. In particular, the intervention encouraged teachers to use small groups to differentiate reading instruction, which intentionally supported students' efforts to work independently and with peers. Our hypothesis was supported to some extent. Students with generally weaker self-regulation who were in ISI intervention classrooms showed greater gains in self-regulation, on average, than did students with similar initial self-regulation skills in control classrooms. These results reveal that ISI intervention training and use of A2i appeared to help teachers organize and plan instruction while encouraging them to deliver instruction in ways that tended to support the development of self-regulation for students who began first grade with weak self-regulation skills. Students with strong self-regulation in the fall maintained these skills overall. Moreover, students with stronger fall self-regulation skills generally achieved stronger reading and vocabulary skills by spring than did students with weaker fall self-regulation skills.

The results of this study showed that ISI group teachers generally spent more time in instruction and productive transitions and less time in disruptions than did control group teachers. Teachers in the ISI group also were more likely to use centers and small group instruction, including providing time when students were expected to work independently as well as with peers. Among treatment group teachers, more time spent planning to individualize instruction using A2i software was associated with fewer disruptions and less time spent disciplining students. We conjecture that these teacher practices were associated with students' self-regulation gains (see Fig. 1). Our study extends prior research by using a randomized control trial to provide evidence that teachers' actions contribute to students' development of self-regulation as well as academic skills (Connor, Piasta, et al., 2009;Domitrovich et al., 2007;Pressley et al., 2001).

Coupling these results with the finding that fall self-regulation skills predicted literacy and vocabulary skill growth reveals that we can manipulate instruction and the classroom environment to promote students' regulatory functions (if they are weak) as well as their literacy skills. These results also elucidate ways that students respond differentially to classroom environments. Our findings suggest that students who enter first grade already able to pay attention, remember instructions, and control their behavior appear to function successfully in a variety of classroom settings; they make self-regulation gains regardless of the degree of disruption or organization occurring in their classrooms. Such students may spend more time on instructional tasks or use instructional time more efficiently because of their capacity to focus their own attention in the face of distracters. These students might also be likely to read on their own during a long transition in which the teacher does not provide an activity. Further, the prediction of spring literacy outcomes from fall self-regulation scores suggests that students who enter the classroom with greater regulatory competence may be better able to take advantage of the literacy instructional activities from the start, which may mean a greater actual impact of the instruction.

In contrast, students who enter first grade with weaker self-regulation may be less well-situated to take advantage of literacy learning opportunities. During lengthy, unorganized transitions they may have difficulty deciding how to use the time productively. As such, these students appear to benefit when their teachers are trained to make a deliberate effort to organize and proactively manage the classroom. Participating in a structured setting where teachers clearly explain rules, procedures, and activity instructions may reduce the attentional and cognitive burden on students for planning their own actions (Lillard, 2005). For example, students in well-organized classrooms are given clear instructions about transitions and carrying out activities. Moreover, it is also possible that students who enter first grade with weaker self-regulation skills are more challenging to manage, and participating in the intervention group allowed teachers to fill their toolbox with strategies to effectively manage instruction for these students. The control group resembles more typical teacher support, without extensive training or assistance in classroom management but with the expectation that teachers identify their own strategies to use. Observational work indicates that variability in classroom environments – including aspects of organization – is typical in the United States (Cameron et al., 2005; National Institute for Child Health & Human Development Early Child Care Research Network, 2002). The present study suggests that an intervention that trains teachers to deliberately plan instruction, in part through providing specific strategies for organizing the classroom, can shrink this variability in teacher practice, help teachers cope more effectively with the variability in student self-regulation, and support growth in students with weaker self-regulation skills.

In examining the association between school SES and students' performance on the HTKS measure, we found that, overall, students from high-poverty schools exhibited generally weaker self-regulation than did students from more affluent schools. These findings reinforce other research showing that students who are at socio-demographic risk for academic failure are more likely to exhibit difficulty with self-regulation and its underlying cognitive components (Connell & Prinz, 2002; Fowler & Cross, 1986; Howse et al., 2003; McClelland, Morrison, & Holmes, 2000). No doubt, the adversity associated with having limited resources and high levels of psychosocial stressors is a significant risk factor in the longitudinal stability of problem behaviors in early childhood (Deater-Decker, Dodge, Bates, & Pettit, 1998). On the other hand, in this study, students in low SES schools were about as likely to show growth in self-regulation as were students from higher SES schools — that is, SES had no substantial effect on self-regulation growth from fall to spring (see Table 7). Thus, according to these results, classroom environments that encourage the development of self-regulation appear to be effective almost regardless of school SES. Such results offer hope because they show that we can intentionally change the classroom environment to enhance the effect of literacy instruction on both reading and self-regulation skills and present an additional path toward helping to close the well-documented achievement gap (Jencks & Phillips, 1998).

The current study has limitations that should be considered when interpreting these results. Whereas randomized control trials are among the most efficient ways to examine the causal effects of interventions (Shavelson & Towne, 2002), we still offer caution in making causal claims that ISI promotes development of students' self-regulation. First, among the treatment group teachers, there was varying fidelity of implementation. That is, teachers used the A2i software for varying amounts of time and varied in the extent to which they demonstrated classroom organization and management skills (see Table 1). This variability can have the effect of dampening effects of treatment. Second, the effect of ISI on students' self-regulation growth was evident only for students scoring in the lower quartile of the sample.

Considering the contribution of students' initial self-regulation and social skills to the learning environment was beyond the scope of this study but is likely important (Skibbe, Glasney, Connor, & Brophy-Herb, submitted for publication). Individualizing instruction might be much easier in classrooms that include a higher percentage of students with strong self-regulatory skills and, in the same way, more difficult in classrooms where many students have weaker self-regulation and behavior problems. In general, educational research is moving away from a unidirectional model (teacher to students), because it is evident from educational research and developmental psychology that human interactions are better described within a transactional, bidirectional framework (Bronfenbrenner & Morris, 2006; Connor, in press). Other, unmeasured aspects of classrooms also likely contributed to students' self-regulation gains, such as the quality of teachers' interactions with students, including strong positive relationships and creating a supportive learning environment (Hamre & Pianta, 2005).

In sum, these results elucidate the central contribution of the classroom learning environment to students' regulatory development as well as to their literacy skills. The ISI intervention and use of the A2i planning software was systematically associated with gains in two vital aspects of first graders' early school repertoires, literacy and self-regulation. For self-regulation, the effect was evident for students who began first grade with weaker regulatory functioning. This study suggests that self-regulation during the early school years may be malleable and that additional emphasis on aspects of the classroom environment that promote self-regulation may help to insure students' school success and higher levels of academic achievement overall.

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Appendix A

Definitions of classroom variables from the coding manual

Code	Description
Non-instruction (selected sub-codes provided below)	Non-instructional (Behavior)
	The Non-instructional behavior should be used to code those activities that do not contain academic content. *The content of activities should be carefully contemplated prior to assigning a Non-instructional code; many seemingly Non-instructional activities may include academic content* (e.g., singing a rhyming song should be coded under Onset/Rime Awareness > Rhyming, using the calendar for pattern recognition or counting should be coded as Math).
Organization	Switch Mode (Modifier)
	Non-instructional > Switch Mode should be coded for short rituals designed to bring students' attention to the teacher or to the next activity, or to help the class calm down or be quiet (e.g., “Hands in the air, hands in your lap,” “Criss-cross applesauce,” “Going on a bear hunt”, turning the lights on/off). Directions or expectations for behavior are embedded in the lyrics of the song or rhyme. These rituals usually have a management purpose and everyone in the classroom knows their meaning. Switch mode serves as a clear, familiar signal for a subsequent activity or expectation, such as snack or being quiet. (Pathways Code)
	Orient/Day (Modifier)
	Non-instructional > Orient/Day should be coded when the teacher shares what students will be doing for the day or explains to students how they should organize their time during the day (for example, the teacher explains that students should work on journaling first, then math, and then free reading). This includes a discussion of the leader of the day, and students' jobs (if they are jobs for the week, code under Non-instructional > Orient/Week; if they are jobs for one activity, code under Non-instructional > Orient/Activity). (Pathways Code)
	Orient/Activity (Modifier)
	Non-instructional > Orient/Activity should be coded when the teacher describes to students an upcoming activity or lesson, explains to them what they are supposed to do, describes each activity available for center time, tells students to which center they should go, etc. (Pathways Code)
	Orient/Classroom (Modifier)
	Non-instructional > Orient/Classroom should be coded when the teacher provides general information to the class about how the classroom functions, and how they are expected to behave in a given circumstance, such as hanging up jackets, washing hands, standing in line, etc. This is time spent explaining everyday procedures and expectations; it does not apply to a particular learning activity or date. (Pathways Code) It can also show praise for positive behavior to discourage negative behavior, for example a teacher can say, “I like the way Shayne is sitting,” to promote other students to follow her example.
	Orient/Week (Modifier)
	Non-instructional N Orient/Week should be coded when the teacher discusses the weekly schedule.
Off Task	Off Task (Modifier)
	Non-instructional > Off Task should be coded when the student is blatantly not completing the activity he/she was assigned, such as being out of their seat for no purpose and/or wandering the classroom. This should not be coded if in Whole Class Grouping because we assume that not all students are on task 100% of the time.
Discipline	Disruption (Modifier)
	Non-instructional > Disruption should be coded when students' work is interrupted. For example, when teachers or students interrupt the class to announce special goings on, or when students' work is interrupted by a fire drill, etc. (Pathways Code) *If students are not disturbed from their work by such an event, it should not be coded.* When students and the teacher are engaging in a reciprocal sharing personal business with the group, this should be coded as Oral Language > Sharing. *A brief description of the disruption should be noted in the comment field.*
	Discipline/Class (Modifier)
	Non-instructional > Discipline/Class should be coded when the teacher takes time to discipline the entire class (for longer than 15 seconds; this probably won't happen very often). This category is distinct from Non-instructional > Orient codes in that *the teacher does not explain expectations*, but rather expresses disappointment or anger, or describes what students did wrong *without including what they should change for next time*. (Pathways Code) Discipline events directed at individuals or small groups is coded under Non-instructional > Discipline/Subset or Individual.
	Discipline/Subset or Individual (Modifier)

Code	Description
	Non-instructional > Discipline/Subset or Individual should be coded when the teacher takes time to discipline a subset of students in the classroom (including an individual student). This category is distinct from Non-instructional > Orient codes in that *the teacher does not explain expectations*, but rather expresses disappointment or anger, or describes what students did wrong *without including what they should change for next time*.
Transition	Waiting (Modifier)
	Non-Instructional > Waiting should be coded when students are waiting for the teacher to begin the lesson, as opposed to the teacher waiting for the students to be ready to begin the lesson (which is coded as Non-Instructional > Transition/Activity or Non-Instructional > Transition/Clean Up.
	Transition/Activity (Modifier)
	Non-instructional > Transition/Activity should be coded when students are transitioning (organizing materials, physically moving, etc.) to a new activity. The majority of students should be involved in some sort of transitioning action; if two students are passing out papers but the rest of the class is merely waiting for the teacher to begin the lesson, this should be coded as Non-instructional > Waiting.
	Transition/Clean Up (Modifier)
	Non-instructional > Transition/Clean Up should be coded when students clean up prior activity's materials or wash their hands for snack. (Pathways Code) This code often results when *students are told to clean up but not told what the next activity will be*. Once students are actually moving into the next activity, this may transition into Non-instructional > Transition/Activity or Non-instructional > Waiting.
	Transition/Line Up (Modifier)
	Non-instructional > Transition/Line Up should be coded when students line up to leave the classroom. (Pathways Code)
	Transition/Bathroom (Modifier)
	Non-instructional > Transition/Bathroom should be coded when students leave the classroom to go to the bathroom. If they're lining up for the bathroom, this is still Non-instructional > Transition/Bathroom, not Non-instructional > Transition/Line Up. (Pathways Code)

Note. The complete coding manual is available upon request from the first author.

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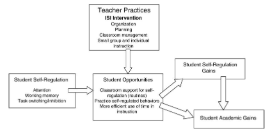

Fig. 1.

Theoretical model examining the mechanisms through which students' self-regulation affects achievement and teachers' practices affect self-regulation and academic development.

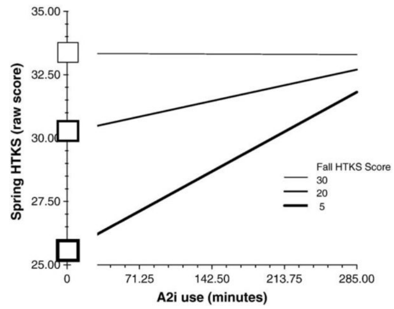

Fig. 2.

Students' spring HTKS score as a function of assignment to control group (A2i use=0) or the ISI intervention group as a function of the number of minutes they used A2i from September to May, modeling range from the 5th to 90th percentile. Boxes represent fitted scores for students in the control group with fall HTKS scores of 5, 20, and 30, respectively. Lines represent treatment group results, which vary as a function of teachers' A2i use. Students' fall HTKS score is modeled for students achieving fall HTKS scores at 5 (heaviest line, weaker), 20 (medium line), and 30 (lightest line, stronger).

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Table 1

Teacher/classroom descriptive information including instruction, non-instruction, and types of each (minutes/day) as well as school SES, A2i use, and teacher descriptives for treatment and control classrooms.

Variables	**Treatment group (*n*=201)**		**Control group (*n*=244)**		**Total (HLM)**	
	M	***SD***	***M***	***SD***	***M***	***SD***
Classroom observation variables						
Total Instruction (minutes/day)	89.79***	12.37	73.37	21.77	81.37	17.87
Types of Instruction						
Teacher/student-managed small group instruction (minutes/day)	14.57***	9.8	10.34	8.46	12.27	9.33
Student/peer-managed small group (minutes/day)	3.61***	2.14	2.99	1.34	3.27	1.77
Student-managed independent work (minutes/day)	26.73 ***	7.02	21.06	8.14	23.65	8.15
Total Non-instruction including all transitions (minutes/day)	36.54	12.29	31.55	5.41	33.93	9.59
Types of Non-instruction						
Student off-task (minutes/day)	2.45	4.62	1.76	4.19	2.07	4.4
Organization (minutes/day)	4.27	1.36	4.26	2.03	4.24	1.5
Disruptions (minutes/day)	.20***	.26	.96	2.1	.61	1.6
Discipline (minutes/day)	.22	.56	.33	.77	.28	.68
School and Teacher Variables						
School SES (Percentage of students at the school qualifying for free and reduced price lunch (School SES)	72.03***	18.57	47.1	23.1	58.46	25.14
Teacher A2i use (control=0, treatment=number of minutes Sept-May)	160.38	15.11	0	0		
Teacher years of experience	11.86	11.61	9.96	7.98	10.89	9.86
Teacher has Master's degree or greater (%)	42	50	17	38	32	51

*** Group differences are significant ($p \leq .001$).

Table 2

Student descriptive information.

Variables	Treatment group (*n*=201)		Control group (*n*=244)		Total (HLM)	
	M	***SD***	***M***	***SD***	***M***	***SD***
Fall letter–word reading W score	404.51	28.04	415.59	32.47	410.43	31.28
Spring letter–word reading W score	452.02	23.71	457.04	26.44	454.35	25.62
Fall picture vocabulary W score	475.88***	10.39	481.86	10.47	478.81	10.9
Spring picture vocabulary W score	481	9.73	485.58	11.05	483.32	10.76
Fall passage comprehension W score	447.35	20.26	451.76	21.32	449.76	20.94
Spring passage comprehension W score	464.64	15.15	467.92	15.7	466.43	15.52
Fall HTKS total score	30.6	8.96	32.74	5.99	31.72	7.58
Spring HTKS total score	33.2	6.18	34.31	5.07	33.82	5.61
SSRS teacher social scale standard score	96.41	15.94	101.67	18.45	99.38	17.57
SSRS teacher problem behavior standard score	104.66	15.29	100.25	15.45	102.17	15.52

*** Group differences are significant ($p \leq .001$). HLM used for child-level variable Fall Picture Vocabulary, treatment coefficient=−6.23, $p < .001$).

Table 3

Top: HLM coefficients (classroom-mean centered) for self-regulation (HTKS) measures and teacher SSRS subscales (above diagonal) and controlling for fall vocabulary score (below diagonal). Bottom: Pearson correlations among fall achievement and fall self-regulation (HTKS) scores.

Variable	Fall HTKS	Spring HTKS	SSRS social scale SS	SSRS problem behavior SS
Fall HTKS score	–	.33***	.31**	−.27***
Spring HTKS score	.32***	–	.21***	−.16***
SSRS social scale standard score	.24***	.17***	–	−.72***
SSRS problem behavior standard score	−.21**	−.12*	−.71***	–

	LW	PV	PC	HTKS
WJ letter–word identification W score (LW)	–	.37***	.80***	.31***
WJ picture vocabulary W score (PV)		–	.37***	.21***
WJ passage comprehension W score (PC)			–	.35***
Fall HTKS score (HTKS)				–

Bonferroni correction, $p \leq .004$.

* $p \leq .05$.

** $p \leq .01$.

*** $p \leq .001$.

Table 4

Results of multivariate multilevel modeling using HLM with simultaneous outcome variables spring picture vocabulary (PV), letter-word identification (LW), and passage comprehension (PC) predicted by fall selfregulation (HTKS, classroom-mean centered) and fall skills (grand-mean centered).

Variables	Coefficient	Standard error	*df*	*P*
Intercept (fitted mean of the three outcomes, γ_{000})	478.55	.41	47	<.001
Fall letter–word identification W score (γ_{010})	.100	.02	439	<.001
Fall picture vocabulary (γ_{020})	.517	.03	439	<.001
Fall passage comprehension (γ_{030})	.065	.02	439	.006
Fall HTKS score (γ_{040})	.127	.05	439	.008

Tau (β), U_0	**Standard errors of Tau (β)**	**$\varepsilon_{tij}=\Delta$**			
		LWind, π0	972.61	451.79	−138.40
		PCind, π1	451.79	277.66	−59.80
		PVind, π2	−138.40	−59.80	74.73
4.12268	1.67745	Standard Errors of Δ			
		LWind, π0	65.41	32.83	18.77
		PCind, π1	32.83	14.50	7.47
		PVind, π2	18.77	7.47	5.15

Deviance=10518.05. Unrestricted model provided the best fit, χ^2 (4)=864.62, *p*<.001.

The model is as follows where spring LW, PC, and PV comprise a latent variable (Y^*_{tij}), LWind, PCind, and PVind are dummy variables where 1 = respective test and all others=0, and the outcome Ymij is the fitted latent outcome for child i in classroom j:

Level-1 model

$$Y_{mij}=\mathrm{LWind}*Y1*+\mathrm{PCind}*Y2*+\mathrm{PVind}*Y3*$$
$$Y^*_{tij}=\pi_{0ij}+\epsilon_{tij}$$

Level-2 model

$$\pi_{0ij}=\beta_{00j}+\beta^*_{01j}\left(\text{fall LW}_{ij}\right)+\beta^*_{02j}\left(\text{fall PV}_{ij}\right)+\beta^*_{03j}\left(\text{fall PC}_{ij}\right)+\beta^*_{04j}\left(\text{fall HTKS}_{ij}\right)$$

Level-3 model

$$\beta_{00j}=\gamma_{000}+u_{00j}$$

$$\beta_{01j}=\gamma_{010}$$

$$\beta_{02j}=\gamma_{020}$$

$$\beta_{03j}=\gamma_{030}$$

$$\beta_{04j}=\gamma_{040}$$

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Table 5

HLM results: relation of school SES and student-level HTKS.

Outcome	Intercept (fitted mean)	School SES coefficient	Standard error	*df*	*p*
Fall HTKS score	31.52	−.05	.01	46	.001
Spring HTKS score	33.69	−.03	.010	46	.006

With Bonferroni correction, $p \leq .025$. There was significant variability between classrooms for Fall HTKS but not Spring HTKS. The variable School SES was grand-mean centered.

Table 6

Correlations among ISI intervention (A2i use) time spent in instruction, organization, and non-instruction, including subcategories.

Variables	Control vs. A2i use	Instruction	Organization	Non-instruction
A2i use (minutes September to May)	–	.33**	−.06	−.03
Instruction (minutes/day)	.33**	–	.04	.23**
Organization (minutes/day)	−.06		–	.23
Non-instruction (minutes/day)	−.03			–
Disruption (minutes/day)	−24***			
Off-task(minutes/day)	−.06			
Discipline (minutes/day)	−.15*			
Transition (minutes/day)	.32***			

** *p*.05.

*** *p*=.001.

Table 7

HLM results examining the effect of ISI and A2i use (Control=0, Treatment=A2i use in minutes Sept. to May) on self-Regulation gains.

Variables	Coefficient	Standard error	*df*	*p*
Spring self-regulation	33.89	.29	43	<.001
Student-level variables				
Fall letter-word identification	.017	.007	438	.016
Fall picture vocabulary	.010	.02	438	.660
Fall HTKS score	.32	.06	438	<.001
Classroom-level variables				
A2i use	−.002	.002	43	.247
Percentage of students' low SES	−.020	.01	43	.058
Student × classroom-level interactions				
Fall self-regulation × A2i use	−.001	.0002	438	<.001

Random effects	Variance	Chi-square	df	*p*-value
Classroom-level variance	.011	41.70	43	>.500
Student-level variance	27.592			

All continuous variables are grand-mean centered except for fall HTKS score, which is classroom-mean centered.