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Randomized control trial of *Tools of the Mind*: Marked benefits to kindergarten children and their teachers

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Abstract

The kindergarten program, *Tools of the Mind* (*Tools*), has been shown to improve executive functions (as assessed by laboratory measures) and academic performance. The objective here was to see if *Tools* can improve executive functions in the real world (in the classroom), academic outcomes not previously investigated, reduce bullying and peer ostracism, and increase teachers' and students' joy in being in the classroom. This first randomized controlled trial of *Tools* in Canada included 351 kindergarten children (mean age 5.2 years at entry; 51% female) in 18 public schools. Stratified randomization resulted in teachers and students in both groups being closely matched. Teachers in both groups received the same number of training hours and same funds for new materials. Outcome measures were pre and post standardized academic skill assessments and teacher online survey responses. This study replicated that *Tools* improves reading and shows for the first time that it improves writing (far exceeding levels the school districts had seen before), self-control and attention-regulation in the real world (e.g., time on task without supervision), reduces teacher burnout and children being ostracized or excluded, and increases the joy students and teachers experience in school. By Spring, *Tools* teachers were still enthusiastic about teaching; control teachers were exhausted. These results were not only better than the control group but also better than *Tools* teachers experienced the year before *Tools*. Thus, children in a kindergarten curriculum that emphasized play, improving self-regulation, working together and helping one another, and hands-on learning performed better academically, showed less bullying and peer ostracism and more kindness and helping behavior than students in more traditional classes, and teacher enthusiasm for teaching soared. *Tools* reduced initial disparities separating children, schools, and teachers.

responses to our surveys can be sent to University of British Columbia Behavioural Research Ethics Board (BREB): (ors@ors.ubc.ca).

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Introduction

Self-control and attention-regulation in early childhood are highly predictive of school performance [1–4], workplace success [5, 6], health [6–8], and life satisfaction [9–11]. They are often more predictive than IQ [6, 12, 13] or socio-economic status (SES) [6, 14]. Children who enter school with poorer academic skills and poorer self-control and attention-regulation quickly fall behind and the gap progressively increases in school achievement [14, 15] and health [16, 17]. Hence there is great interest in helping children enter Grade 1 with the academic and executive function (EF) skills they need to launch them on a positive trajectory.

Similarly, social-emotional well-being in childhood predicts better school performance [18–21] and better outcomes on diverse variables in adults [19]. Student bullying and peer exclusion are major social and mental health concerns [22, 23] and classroom stress is causing teachers to burn-out and leave the profession in unprecedented numbers [24–26]. Hence there is great interest in improving students' camaraderie and kindness, and reducing stress, in the classroom.

Much of the focus has been on prekindergarten programs [27–32]. Kindergarten represents a much less-studied context for investigating ways to improve social-emotional and EF competencies. Yet free, public kindergarten is available throughout most developed countries. At least one longitudinal study reports that attending a higher quality kindergarten is associated with higher rates of college attendance and higher earnings in adulthood [33].

This paper reports the results of a study that investigated whether the *Tools of the Mind* (*Tools*) kindergarten program could improve self-control and attention-regulation, academic performance, prosocial behavior, and reduce classroom stress and teacher burnout.

Reducing stress and increasing social harmony are not only important as factors that improve EFs and academic performance, but are important goals in their own right. A program that can reduce ostracism and bullying and reduce teacher burnout is one worth taking a look at. Such a program was examined here.

To unpack the terms used above a bit, self-control and attentional control comprise the "inhibitory control" component of EFs [34]. Self-control involves resisting temptations (including all the temptations not to stay on task or see it through to completion) and resisting speaking or acting reflexively (e.g., instead of responding immediately, giving oneself time to think or calm down before acting). Attentional control involves resisting distractions, being able to pay attention and stay focused for an extended period.

These inhibitory control abilities are critical for success in school [1–4] and in social relations [35–37]. They are needed for inhibiting all the pulls not to pay attention or stay focused and also for complying with school norms, such as staying seated or raising one's hand, and social norms, such as not grabbing what someone else has or not talking while someone else is speaking. This is probably one of the many reasons why EFs, social-emotional competence, and academic performance are highly interrelated, e.g. [38–40].

The other EFs are working memory, cognitive flexibility, reasoning, and planning [34], but it is inhibitory control that is most predictive of long-term outcomes [6, 7]. A reasonable prediction is that a school program that improves inhibitory control, in addition to addressing academic skills, should produce better academic outcomes than programs that address academic skills but do not address inhibitory control or do so less successfully. We tested that prediction here.

If a person feels lonely or rejected, or is stressed or sad, that negatively impacts inhibitory control, academic performance, and physical and mental health (evidence that loneliness impairs EFs and specifically inhibitory control [41–43], academic performance [20, 44], and health [42, 45–47]; evidence that stress impairs EFs and specifically inhibitory control [48–50],

academic performance [51–53], and health [54–56]; evidence that prolonged sadness impairs EFs and specifically inhibitory control [57–59], academic performance [60, 61], and health [62–65]. Therefore, a reasonable prediction is that in a school program that promotes students working together and being kind to and supporting one another (i.e., prosocial behavior [66]) one should find less peer rejection, more joy in the classroom, less teacher burnout, and better student academic performance and inhibitory control.

Tools is a kindergarten curriculum that focuses as much on improving EFs (especially inhibitory control), classroom climate, prosocial behavior and interpersonal skills as on improving academic skills. There is already evidence that it improves EFs, academic performance, and teacher-child relationships and reduces aggression [67–69], though when only parts of the program have been implemented as an add-on to the curriculum, those benefits have not been observed [70, 71].

Three independent evaluations of *Tools* have been published. The first, published in *Science* [69], found that recent graduates of *Tools* showed much better attention-regulation on a Flanker-type task (85% vs. 50% correct) than controls. Children were not evaluated before the intervention so it is possible that children in *Tools* had better attention-regulation at the outset, though the groups were closely matched on many demographic variables. At-risk, low-income children had been randomized to *Tools* or to another new curriculum that the school district had developed and predicted would outperform *Tools*. One school became so impressed by how much *Tools* children were out-performing others that they dropped out of the study and switched all kindergarten classes to *Tools*, feeling it unethical to deprive any of *Tools*.

A much larger study [67, 68] found better and more improved vocabulary, math, teacher-reported teacher-child relationships, and emotion-regulation on the dot-probe task. They did not find, however, better or more improved inhibitory control or cognitive flexibility on the Hearts and Flowers task, card sorting, or Flanker tasks in kindergarten children in *Tools* versus controls. They also found less and more reduced teacher-reported conduct problems or aggression in kindergarten children in *Tools* versus controls. Academic benefits were even larger the following year (Grade 1), where gains in reading first became evident. Effects were about eight times larger in low-income schools.

The third study [72] compared a daycare-based *Tools* program for children 3–4 years old to a high-quality, existing play-based program. Children in *Tools* whose parents rated them as highly hyperactive and/or inattentive in the Fall showed greater gains on an inhibitory control task of self-control than control children. The authors concluded that "*Tools* may be advantageous in classrooms with children experiencing greater challenges with self-regulation, at no apparent cost to those less challenged in this regard" (p. 2).

We predicted we would find benefits from *Tools* on important variables not previously investigated: (a) the academic skill of writing, (b) camaraderie and helping one another in the classroom, or its flip side reduced peer ostracism and exclusion, (c) teachers' joy in teaching, (d) students' joy in learning, and (e) EFs in the real-world versus on laboratory measures (specifically the ability to inhibit distraction in the classroom and stay on task), in addition to replicating previously demonstrated benefits to reading. We predicted that classrooms with less play, hands-on learning, or incorporation of training and scaffolding of EFs in school activities, even if they spent more time on academic content, would be less successful in improving academic outcomes and would be characterized by greater stress in the classroom and more teacher burnout.

Research design

The year before implementation, all public elementary schools in Vancouver and Surrey, the two largest school districts in British Columbia (BC), Canada, were queried to see if a

kindergarten teacher at the school was interested in implementing *Tools* and if the principal was also supportive of that. All schools where both the principal and at least one kindergarten teacher responded 'yes' were included in the pool from which random selection was made. This was done because one would expect implementation of *Tools* to be poor where the teacher or principal did not want it, and the strong teachers' union would not allow teachers to be told to implement a test curriculum they did not want.

Because teachers, principals, or schools open to implementing *Tools* might differ from those unwilling to go to the effort to learn and implement a new curriculum, we also selected the control schools from the same pool of schools. Within each city, pairs of closely-matched schools were created from this pool (matched on the relevant kindergarten teacher's years of experience and training and on socio-economic characteristics of kindergarten children at the school including ethnicity, subsidized lunch status, and home language). Ten pairs were randomly selected and one member of each was randomly assigned to implement *Tools*.

This study had human subjects research ethics approval from the University of British Columbia, Vancouver School Board, and Surrey School Board. Informed written consent was obtained from all teachers for their participation and all principals for their school's participation. The only data from children were their scores on BC assessment tools and their ESL and subsidized-lunch status, which the school districts collects as part of their educational mission, and which we received aggregated by classroom. Since we did not collect any data directly from the children we did not request consent from them or their parents.

One pair dropped out a couple of months into the school year. Both teachers had personal, family reasons for not being able to participate in the study. We thought it would be too difficult for a teacher new to *Tools* to catch up at that point, so did not replace that pair.

Control condition: Existing curriculum in BC kindergartens + special workshops

Kindergartens in BC are all full-day. Most kindergartens have 20–22 students. All follow the same prescribed learning outcomes and principles of appropriate practice [73]. Thus, the curriculum is the same in Vancouver and Surrey, and in *Tools* and control classes. The BC Ministry of Education is committed to educating children not just in academics but also in social responsibility. Most teachers (89% of control teachers and 77% of *Tools* teachers) had received training in the *Second Step*® social-emotional learning (SEL) program that teaches social skills, empathy, and emotion management [74]. Additionally, 56% of control teachers and 50% of *Tools* teachers had received training in the *MindUp*™ program (which teaches social and emotional skills and mindful awareness) [75].

There was play in control classes, but it was usually unsupervised or scripted, not as in *Tools*. (For example, a child in *Tools* might record a plan to play an astronaut today. Early in the year, he might abandon that after 1–2 minutes to play something else. In control classes that would be fine. In *Tools*, the teacher comes over with the child's plan, "You need to follow through with your plan. You can be something else tomorrow." Children in control kindergartens do not tend to make plans. By the Spring, *Tools* children sustain make-believe dramatic play for 25–30 min without adult guidance; control children tend to do so for only a few minutes).

Control kindergartens had more 'whole group' activities. In *Tools* kindergartens, children worked more independently in pairs or small groups. Control kindergartens used rewards (e.g., gold stars); *Tools* does not. Time-outs are used in control classes, but not in *Tools*.

Experimental condition: *Tools of the Mind*

The *Tools* curriculum, which exists only for preschool and kindergarten, is grounded in the idea that social-emotional development and improving EFs, especially inhibitory control, is as important as teaching academic skills and content. Developed by educational psychologists, Bodrova and Leong [76], *Tools* is based on the work of Vygotsky [77, 78] and has been revised and improved over 23 years of iterative research and implementation.

Vygotsky emphasized that cognitive and social development are fundamentally intertwined and that social interactions are key to developing EFs and cognitive skills, thus in *Tools* there are not separate activities for academics and SEL, rather activities address both. That makes *Tools* rather unique. Tools teachers are taught how to foster paired activities and an atmosphere of cooperation and mutual support. A major difference between *Tools* and traditional kindergarten is the far greater use of peer social interaction for learning in *Tools*–two children helping one another, cooperating in learning the material together or in one teaching or checking the other. Children learn to help bootstrap one another's EFs, providing helpful reminders to each other. Consistent with Vygotsky's view that language is central to EF development, Tools provides specially designed opportunities for children to talk to each other, thus aiding the development of oral language as a tool for social interaction and encouraging the emergence of private or "inner" speech that serves as a mechanism for self-regulation [79, 80].

Vygotsky also emphasized the importance of social pretend play (e.g., playing doctor and patient or grocery store) for the development of EFs in young children. It is an important component of *Tools*. The quantity and quality of social pretend play in *Tools* distinguishes it sharply from traditional kindergarten. Children enact roles with implicit rules, role speech, and the use of symbolic props (e.g., a block might be a phone or a loaf of bread). Mature make-believe play challenges and helps build all three core EFs: Children must inhibit acting out of character (inhibitory control), hold in mind the role they've chosen and those of others (working memory), and flexibly adjust as their friends take the scenario in unexpected directions (cognitive flexibility).

Each child is paired with every other at least once every week in *Tools*. Students adapt to the personal quirks of their classmates. They know if they are not paired with their favorite person it won't last long, everyone will also be paired with this person, and soon they will be paired with someone else, so complaining about being "stuck" with someone (so common in the early grades) is absent.

Another marked difference between *Tools* and traditional kindergarten is the far greater time children spend in hands-on learning and far less time in teacher-led whole-group activities in *Tools*. As one teacher put it, with *Tools* she is the "Guide on the Side" rather than the "Sage on the Stage." At any age we learn something better when we need it for what we are doing [81, 82]. For young children that is particularly important because they have such difficulty sitting and listening for any length of time.

Because children can work on their own or with one or two others, teachers can provide individualized instruction and assessment. A *Tools* teacher helping one child is not taking time away from others because others are engaged in meaningful activity. Because children can work on their own they can proceed at their own pace, without rushing other children or holding them back. The use of self-correcting materials enables children (or their "study buddy") to detect and correct errors without the teacher having to tell them.

Rather just assessing a child's current level of competence (as do standard assessments), *Tools* teachers use dynamic assessment to determine a child's readiness to advance or why the

child is having difficulty grasping something. This consists of a series of prompts and hints to probe children's skills and understandings that are "on the edge of emerging [78]."

Weekly one-on-one Learning Conferences with the *Tools* teacher engage the child in planning his/her own education, empowering the child to take a lead role. Children "talk through" both correct and incorrect answers, helping them learn to reflect on and correct mistakes. In these conferences errors are treated as valuable learning opportunities, not anything to be embarrassed about.

A distinguishing feature of *Tools* is the absence of extrinsic incentives, such as stickers or gold stars. The *Tools'* philosophy is that learning and developing mastery are intrinsically rewarding, and that external rewards would convey the wrong message.

An example of paired peer-social interaction in learning activities as well as how training EFs is seamlessly incorporated to *Tools* academic activities is the *Tools* literacy activity called "Buddy Reading." Children pair up to take turns "reading" their picture book to one another. With each child eager to tell his or her story; no one wants to listen. To help the children succeed at exercising inhibitory control, the teacher provides scaffolds (one child per pair gets a line drawing of lips and the other a drawing of an ear); the teacher explains that "ears don't talk; they listen." This enables the child with the ear to inhibit talking and to listen. Children then trade drawings and roles, thus learning to enact the social norms of taking turns and waiting one's turn. After a few months, the pictures are no longer needed; children can succeed without them.

This illustrates another key aspect of *Tools*: Rather than letting children flounder, teachers provide supports (scaffolds) so that most children, regardless of ability level, succeed. Concrete visual signs and symbols help bootstrap fragile working memory and language skills. Classroom materials have few distractions, thus making attention regulation easier. These supports are gradually removed as children improve. Thus children succeed, instead of experiencing failure or criticism. The boost to self-confidence and self-esteem from experiencing success is one key element of *Tools*. Indeed, testers in one study of *Tools* [69] could tell which children had been in *Tools* because on the most difficult conditions control children gave up but *Tools* children insisted, "I know I can do this. Let me try again."

Because scaffolds and other children help students inhibit their impulsive behaviors and act appropriately, *Tools* teachers have less worries about students misbehaving; they can relax. Having fewer worries about being reprimanded, the children can relax.

For those wanting more information, S1 File provides a brochure about *Tools*.

Comparability

We went to lengths to treat both *Tools* and control teachers comparably. *Tools* teachers received a three-day workshop on *Tools* before the school year began. We offered control teachers three days of workshops at the same time on whatever they wanted. They made suggestions and voted on them. Their workshops received excellent reviews from the teachers. (They chose one-day workshops on "Using Technology in your Kindergarten Classroom," "Teaching Children with Autism Spectrum Disorder," and "NOT your typical approach to Math in Kindergarten.") Both groups of teachers were comparably compensated for their time in attending the three days of workshops. The four one-day workshops for *Tools* teachers during the school year were held on Professional Development Days when school districts arranged for instruction and enrichment programs for teachers.

Kindergarten classes in the US usually have a teaching assistant besides the teacher; kindergartens in BC do not. *Tools* needs such an assistant for the 90-minute literacy block each morning. Therefore, we paid a token $30/day for kindergartens in both groups to have an

assistant for 90 minutes daily. Typically the assistant was a relative of one of the children in the class or a friend or relative of the teacher. Teachers in the *Tools* group needed to purchase supplies. Therefore, all teachers in both groups received an allowance of $1,000 to purchase supplies for their classroom. All funds for this came from the BC Ministry of Health and BC Mental Health Foundation.

There was one unintended difference between the *Tools* and control groups: *Tools* teachers chose on their own to meet together a few times during the school year (besides when there was a workshop)—thus providing social support and enabling each to learn from one another. This probably helped less-experienced teachers to do so well with *Tools*. (Had we known about these meetings, we would have arranged for similar meetings for control-group teachers).

Assessments

Pre-intervention levels of the children on language and math skills and on behavioral control and sociability were determined within the first month of school. Post-intervention levels were determined eight months later (May 5–15). Academic skills were assessed using BC's objective, standardized assessment tools [83] including the Developmental Reading Assessment (DRA2)™ [84] (see S2 File). These results were also obtained for the pre-*Tools* year for the classes taught by teachers assigned to *Tools*. Reading and writing were done in English. Students' attitudes and behavior were reported by teachers. Teachers responded to an online survey (using the Survey Monkey platform) with multiple-choice questions and open-ended opportunities to elaborate. The survey questions are provided in S3 File.

Data analyses

Since randomization was at the level of schools, analyses of student outcomes were nested within schools. Since the data were often ordinal, binary, or not normally distributed, in most cases the generalized estimating equation was used for data analyses, as it provides valid inferences regardless of the data distribution and is robust for both parametric and non-parametric analyses. Chi-squares were generated from the generalized estimating equation within a poisson loglinear model when the data distribution was skewed, or, for categorical data, a binary logistic model. For interval data, where the data were roughly normally distributed and the variances roughly equal between groups or could be made so by a transformation such as arcsine, analysis of variance (ANOVA) was used to compare one group to other. Linear regression was used for the analysis of whether *Tools* helped the children more behind in reading more than those who started out reading at a higher level.

S4 File presents the results for all of our statistical analyses controlling one at a time for free-lunch status, ESL status, and years of teaching experience. With nine classrooms per condition, we do not have the power to control for more than one covariate at a time. Free-lunch status was occasionally related to our outcome measures, as was ESL status, years of teaching rarely. All analyses are reported in this paper controlling for free-lunch status (as a proxy for lower SES). To see the results controlling for ESL status or years of teaching please refer to S4 File.

Since the dependent measures are interdependent and interrelated, one could argue that correcting for multiple comparisons is not needed. On the other hand, with several dependent variables we felt some correction should be applied. As a compromise between those two viewpoints, we have divided the normal significance level in half and required $p < 0.025$ for a result to be considered statistically significant. To help illuminate the reasons behind why statistical differences were found and to put a human face on them, direct quotations from teachers' survey responses are included in S5 File.

Results

Descriptive statistics

Teachers and students were well matched in the two groups. See Table 1. Most teachers in both groups were outstanding and very experienced. There were nine teachers (schools) per group; 172 children in the *Tools* group; 180 children in the control group.

Reading

At the beginning of kindergarten, most children could not read even the simplest words. Most classes had no child who could read more than the simplest sentences; the exceptions were one *Tools* class and three control classes which each had three children who could read at a higher level. No significant difference in reading skills was found between *Tools* and control classes in September.

By May, eight of the nine *Tools* classes had more than two children reading at Grade 1 level or higher, while only one of the nine control classes had more than two children reading at Grade 1 level or higher. Children in *Tools* made significantly greater progress in reading than children in the control group ($\chi^2(1, N = 18) = 4.64$, $p = 0.02$, odds ratio = 3.25). Three times more children were reading at Grade 1 level or higher by May in *Tools* classes than in control classes (33% vs. 10%): $F(1,15) = 6.67$, $p < 0.02$, partial eta squared (ηp^2) = 0.33. See Fig 1.

Table 1. Descriptive statistics.

Measure	Tools teachers	Control-group teachers
Means years of teaching (SD)[A]	16 (4.9)	15 (7.4)
Range of years of teaching	1–20	7–29
Mean years of teaching kindergarten (SD)	7 (3.6)	8 (4.1)
Range of years of teaching kindergarten	1–15 years	2–13 years
Mean # of children in each class (SD)	19 (2.0)	20 (1.4)
Range of # of children in each class	17–22	18–22
Total number of children in each group	172	180
Percentage of girls in each group	50%	52%
Mean age in years of kindergarten students on Sept. 15 (SD)	5.03 (0.5)	5.10 (0.6)
Mean # of special-needs children per class (SD)	2.0 (1.0)	2.5 (1.9)
Range of # of special-needs children per class	0–4	0–5
Mean # of ESL[B] children per class (SD)[C]	6.5 (5.5)	13.0 (5.7)
Range of # of ESL children per class	0–14	2–19
Mean # children on subsidized lunch (lower income)/class (SD)[D]	4.2 (1.6)	1.8 (2.0)
Range of # of children on subsidized lunch per class	0–12	0–10
# of classes with no child on subsidized lunch	6	8
# of classes with 44% of children on subsidized lunch	1	0
# of classes with 53–55% of children on subsidized lunch	1	1
# of classes with 71% of children on subsidized lunch	1	0

[A] SD = standard deviation

[B] ESL = English as a second language

[C] There were more ESL children in the control group than in the *Tools* group ($F[1,16] = 6.52$, $p < 0.02$, partial eta squared [ηp^2] = 0.31).

[D] There was a tendency for more lower-income children to be in *Tools* classes than control classes ($F(1,16) = 4.46$, $p < 0.05$, $\eta p^2 = 0.25$).

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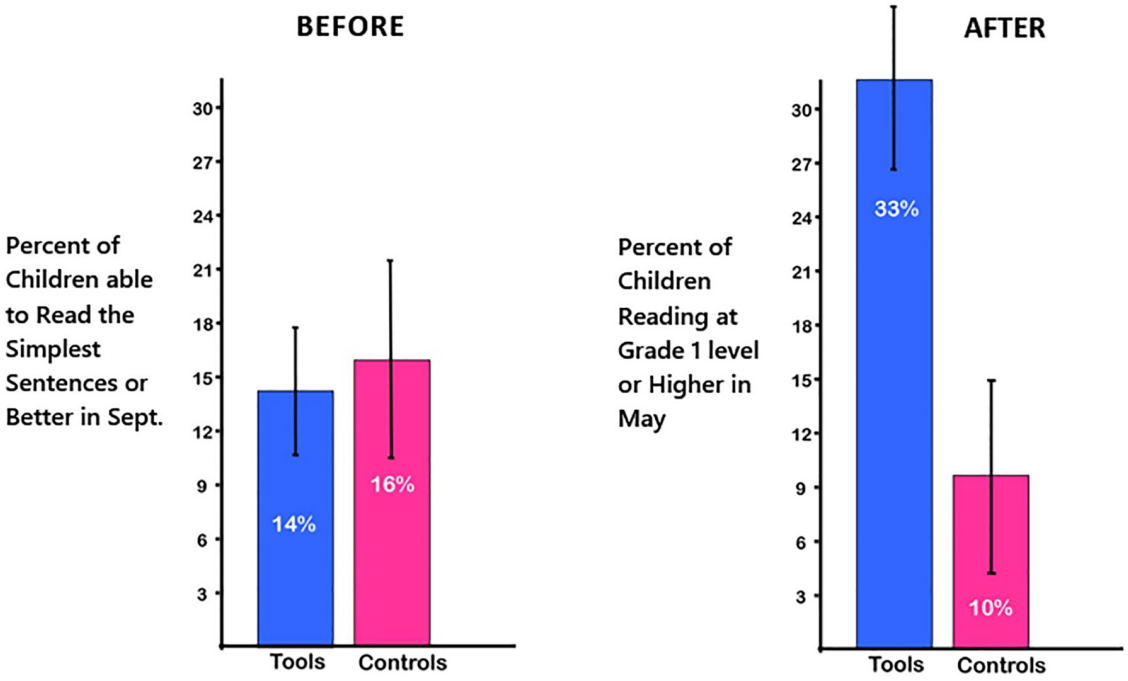

Fig 1. Reading skills. By May, three times as many children in *Tools* than in control classes were reading at Grade 1 level or better, although both groups started out comparably in the Fall.

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Conversely, almost three times more children were still non-readers by May in control classes than in *Tools* classes (28% vs. 10%): $F(1,15) = 6.02$, $p = 0.02$, $\eta p^2 = 0.29$.

This better progress in reading with *Tools* was also reflected in comments by teachers and parents (see S5 File–Comments by Teachers, Parents, and Principals). Most *Tools* teachers said they had never seen progress like this in reading before.: "The literacy level in the classroom this year is much higher [than in past years]."

Lower-income children in *Tools* (those receiving subsidized lunch at school) did not show greater progress in reading than did children in *Tools* from more prosperous homes ($\chi^2(1, N = 9) = 4.17$, $p = 0.12$ [NS], odds ratio = 2.05; here the covariate was ESL status instead of subsidized lunch). With only nine Tools classes, though, there was limited power to detect a difference. The reading of those who started farther behind in September, however, showed far more progress than the reading of those who started out reading at a more advanced level, as the regression of the difference in reading level (May minus September) against reading level in September shows: $F(2,6) = 18.18$, $p < 0.005$, $R^2 = 0.89$.

Writing

Children in the two groups started out similarly in writing ability ($\chi^2(1, N = 18) = 1.45$, $p > 0.20$ [NS], odds ratio = 1.10). In September, roughly three children per class in both groups (range = 1–5) could do no better than scribble. In 67% of *Tools* classes and 56% of control classes, most children could write their first name without copying (85% of children in *Tools* and 87% of control children). By May, almost all children in both groups could do better than that. The difference was in how far they had progressed. Children in Tools progressed much farther ($\chi^2(1, N = 18) = 20.20$, $p < 0.001$, odds ratio = 26.18). Three times as many children in *Tools* versus control classes reached as far as being able to write a full sentence they

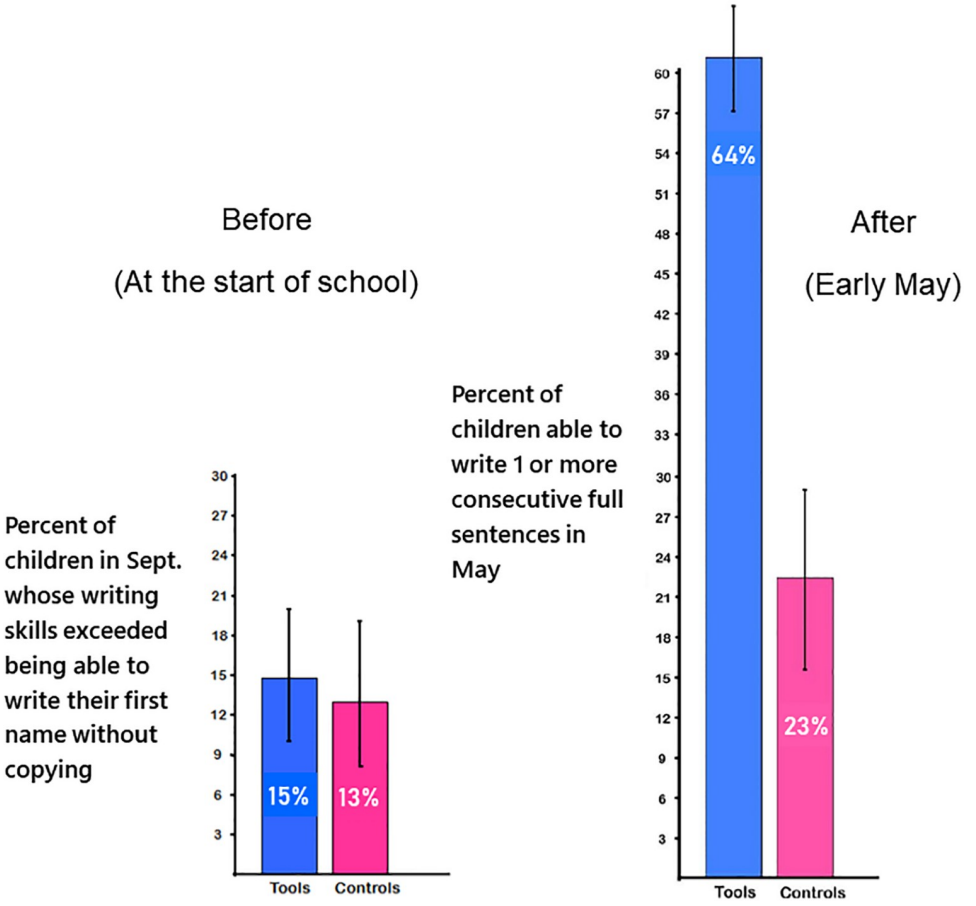

Fig 2. Writing skills. By May, three times more children in *Tools* than in control classes were able to write a full sentence they themselves composed or multiple consecutive ones ($F[1,15] = 18.10$, $p < 0.001$, $\eta p^2 = 0.55$).

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themselves composed with most sounds represented (30% vs. 10%). Almost three times as many children in *Tools* versus control classes progressed further than that; they could write 2 or more consecutive sentences they composed with most sounds represented (33% vs. 12%). More children in *Tools* than in control classes progressed from September to May to being able to write a full sentence or multiple consecutive ones that themselves composed with most sounds represented: $F(1,15) = 18.10$, $p < 0.005$, $\eta p^2 = 0.55$. See Fig 2.

It is not so surprising that the writing of children in *Tools* advanced further than the writing of control children since *Tools* emphasized writing and control classes did not, though the advanced level of writing by children in *Tools* would astonish most kindergarten teachers. Indeed, we had to add questions about children's writing skills to the online teacher survey because the writing levels achieved by children in *Tools* exceeded the upper limits on the BC assessment tools for kindergarten. Teachers reported never having seen writing progress like this before (see S5 File) and the data bear them out (see Fig 3).

Math

Both groups started out with virtually no math skills. Because of the complexity of implementing *Tools* for the first time in Canadian kindergartens, and because of a decision to concentrate on language skills, math was not a focus of the *Tools* program in Year 1 of its implementation

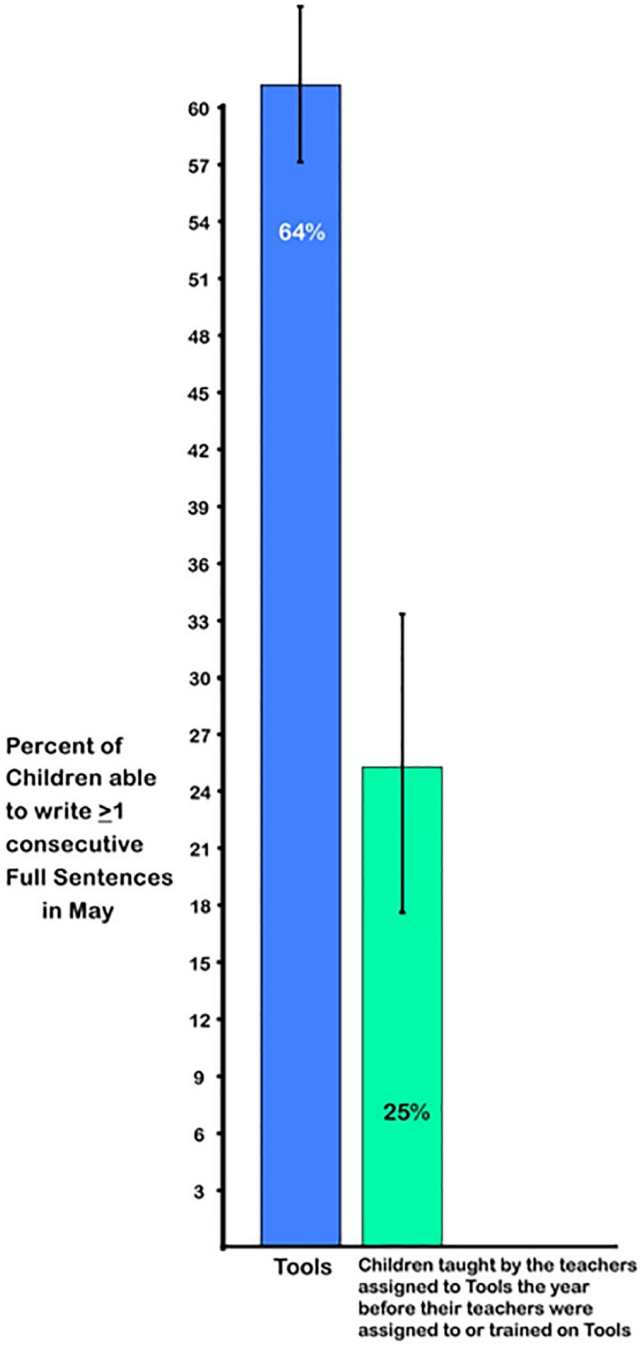

Fig 3. Percentage of children able to write at least one sentence they composed, comparing outcomes for children taught by the teachers assigned to *Tools* in the pre-*Tools* year (before *Tools* was implemented) and Year 1 of *Tools*. Children taught by the same teachers the year before those teachers implemented *Tools* were significantly less advanced in writing than children taught by those teachers the next year when they were implementing *Tools*: $\chi^2(1, N = 8) = 13.54$, $p < 0.01$, odds ratio = 9.42).

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in BC. Thus, the developers of *Tools* and local *Tools* coaches did not expect *Tools* children to advance more in math than did controls, but they came close to doing so: In eight of the nine *Tools* class, most children progressed to being able to do simple addition and in four of the nine most progressed even farther to simple subtraction. In no control class were most

children able to do simple subtraction. At the lower end of continuum, in only two *Tools* class were most children able to do no better than to count up to 20 objects, while that was true for four of the nine control classes. Neither the difference between Tools and control classes in the percentage of children who could do no better than count up to 20 objects in May nor the difference in the percentage who could do simple subtraction by May reached significance however ($F(1,15) = 3.16$, NS; $F[1,15] = 1.17$, NS; $F[1,15] = 1.77$, NS, respectively).

Social inclusion and other prosocial behavior

Both groups started off comparably. *Tools* teachers reported that in the Fall they had 3–8 children who had difficulty interacting in the classroom (mean (SD) = 5 (0.7) per class; 26%). Control teachers reported that they had 0–9 children who had difficulty interacting in the classroom (mean (SD) = 4 (2.5) per class; 20%). By May, the percentage of children reported to be having problems interacting was lower in Tools than in control classes ($F[1,15] = 6.83$, $p < 0.02$, $\eta p^2 = 0.31$) and it had gone down much more in *Tools* than in control classes ($F[1,15] = 20.59$, $p < 0.001$, $\eta p^2 = 0.58$).

Tools teachers commented, for example: "In years past, they have not helped each other to this degree. This year I have witnessed many students going to another student's aid." "They offer help and assistance when needed without being asked and without belittling the struggling student. They look out for one another and ensure everyone has someone to play with or talk to." "They are cheering each other's success, are more supportive of each other." "More of a sense of community [this year]. I see children helping each other and looking after each other to a greater degree from in the classroom to out on the playground at recess [than in past years]." See more comments on this topic in S5 File.

On the other hand, control teachers commented, for example: "[We] have a few children who have a very difficult time acting kind most of the time. This makes it difficult to have a totally close knit community, as these children, while they have progressed, still need significant support to make choices that benefit everyone and not just themselves." "The students are learning to read and write, but their ability to be well-adjusted and considerate human beings lags behind." More comments by control teachers are provided in S5 File.

Only 22% of *Tools* teachers reported the presence of cliques in their classes compared with 89% of control teachers. The difference in the incidence of teacher-reported cliques was significant: $\chi^2(1, N = 18) = 11.99$, $p < 0.001$, odds ratio = 15.77). Fully 89% of control teachers reported in May that there was at least one child in their class who tended to be ostracized or left out; only 33% of *Tools* teachers reported that. Instances of a student being left out or ostracized were noticeably more common in control *versus* Tools classrooms: ($\chi 2(1, N = 18) = 4.87$, $p = 0.02$, odds ratio = 3.45). Teachers' comments echo the stark difference evident in Fig 4 (see S5 File).

Attention-regulation and self-control

Ability to get back to work after a break. Back in the Fall, most teachers in both groups (89% in each) felt their students were *not* good at getting back to work after a break. Though comparable in the Fall, the groups differed by the Spring. ***All*** *Tools* teachers reported their students were good at getting back to work after recess and weekends; only 56% of control teachers reported that ($\chi^2(1, N = 18) = 5.31$, $p < 0.02$, odds ratio = 5.28; see Fig 5). Many *Tools* teachers mentioned how different this was from past years, e.g., "In 20 years I have never been able to come back from school holidays so seamlessly." This difference already emerged by Spring break ($\chi 2(1, N = 18) = 4.92$, $p = 0.02$, odds ratio = 3.50). Eighty-nine percent of *Tools* teachers agreed strongly that their children had been good at getting back to work after Spring

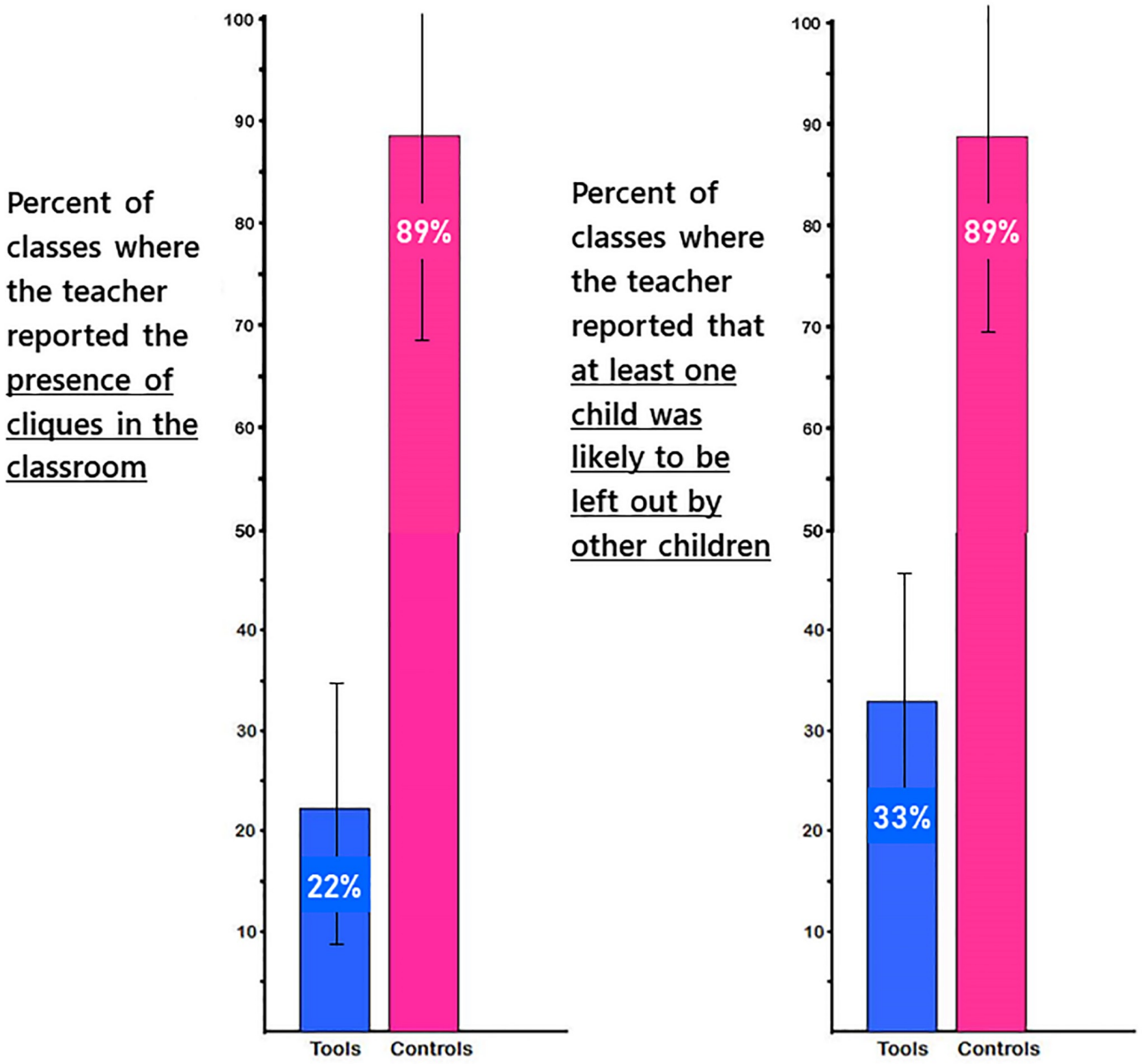

Fig 4. Teacher reports of peer rejection and presence of cliques about here. In-groups and out-groups and peer rejection or exclusion were the norm in control classes and rare in *Tools* classes.

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break; ***no*** control teacher strongly endorsed that. Indeed, 56% of control teachers disagreed, saying that their children had ***not*** been good at getting back to work after Spring break; only one *Tools* teacher disagreed.

Ability to work independently, without supervision. In the Fall, 55% of teachers in both groups said that children in their class were not capable of working on their own at all without supervision, even for a minute. The percentage of teachers endorsing that their children could work on their own for just 1–2 minutes without supervision was 44% for *Tools* and 33% for control teachers. Only one teacher said her students could work on their own for 3–5 minutes without supervision; that teacher was in the control group. By May, teachers in *Tools* said their

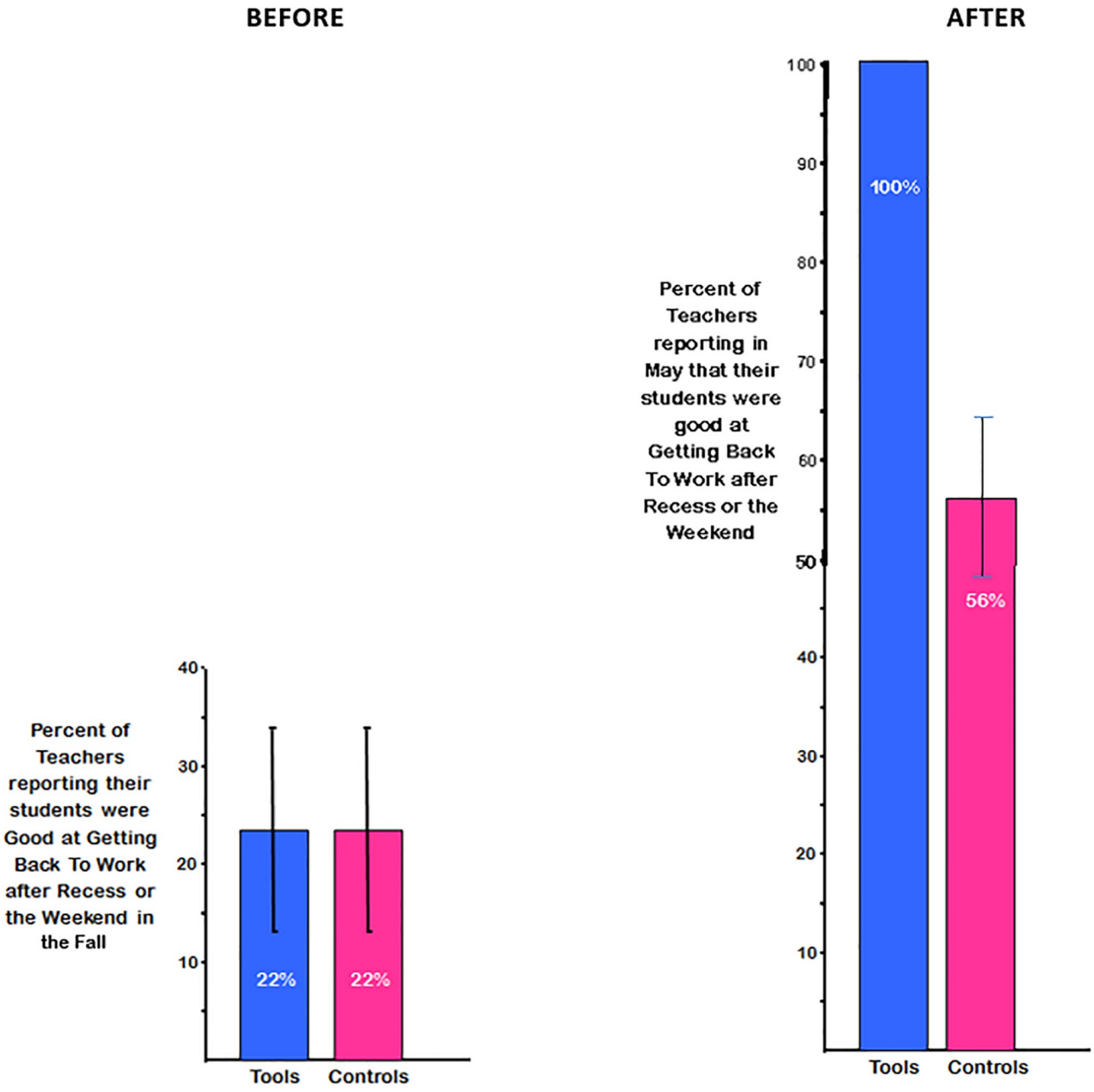

Fig 5. Teachers' perceptions of students' ability to get back to work after a break. In the Fall, few teachers thought their students were good at getting back to work after a break. By the Spring, Tools teachers were almost twice as likely as control teachers to think their children now were good at getting back to work after a break.

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children could be left to work without supervision for far longer than control teachers: $F(1,15) = 11.43$, $p < 0.005$, $\eta p^2 = 0.43$. See Table 2 and Fig 6.

In their comments, teachers elaborated at length about this, and how different the experience this year in *Tools* classes was from previous years. See comments about this by *Tools* and control teachers in S5 File.

Tools teachers further commented on what the children's better EF abilities to stay on task and control their attention and behavior has meant for what they can do in class: "The ability

Table 2. Teachers' responses to the question, "If someone comes in your room now [in May], how long do you feel you could talk with that person and let the children in your class work on their own without supervision?".

Teachers' estimates in May of how long children in their class could work on their own without supervision	Percent of *Tools* Teachers	Percent of Control Teachers
> 15 min	22	0
11–15 min	33	0
9–10 min	33	11
6–8 min	11	33
3–5 min	0	33
≤ 1–2 min	0	22

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of my students to regulate their behaviour and to help those who still require some assistance has allowed me to be able to work with small groups as well as individually with specific students who require additional assistance. I have never been able to effectively do this ever with kindergarten students before." "They are very self-regulated so I am able to work with a small group without being distracted. This is a wonderful gift." "I have the freedom to work with small groups and help children learn at their own level; it helps provide students help where they need it and move them further faster. It is definitely more individualized. . .. Students easily work in small groups and can self-regulate while I work with students who need support."

Teachers' feelings about teaching

We asked teachers to rate how they were feeling in May on a scale of 1 (excited about teaching, energized) to 10 (exhausted, burned out, weary) and to rate how they felt looking ahead to the next school year from 1 (excited about starting again, totally enthused) to 10 (not looking forward to it, looking forward to retirement). To both questions, over three-quarters of *Tools* teachers chose #1 or #2; ***no*** control teacher did. They were exhausted. See Fig 7.

Comments by *Tools* teachers indicated that students' joy in coming to school, excitement about learning, and marked progress were the main contributors to their own excitement about teaching: "I have seen so much success in my students' learning that I can't wait to begin teaching again next year now that I have a better understanding of the program and all of its benefits!" "I have enjoyed seeing the students get so excited about coming to school and learning. . ..[M]any students refused to miss school even if they were sick." "What I have enjoyed most about my class this year is. . . The smiles and joy." "What I liked most about teaching this year: Students' enthusiasm towards learning and their pride in their development." More comments by teachers are provided in S5 File.

Change in teachers' expectations of what kindergarten children are capable of

Tools teachers also expressed how their expectations for what the children could accomplish had changed, as had those of the parents: "Children in kindergarten are capable of so much more than I imagined." "Parents are astonished with what their children can do." "New kindergarten parents are pleased; parents who have had another child in kindergarten are amazed this year with what their children can do."

Discussion

This study found that *Tools* not only improves academic outcomes in reading and writing, but also shows for the first time that *Tools* also improves EFs in the classroom (being able to stay

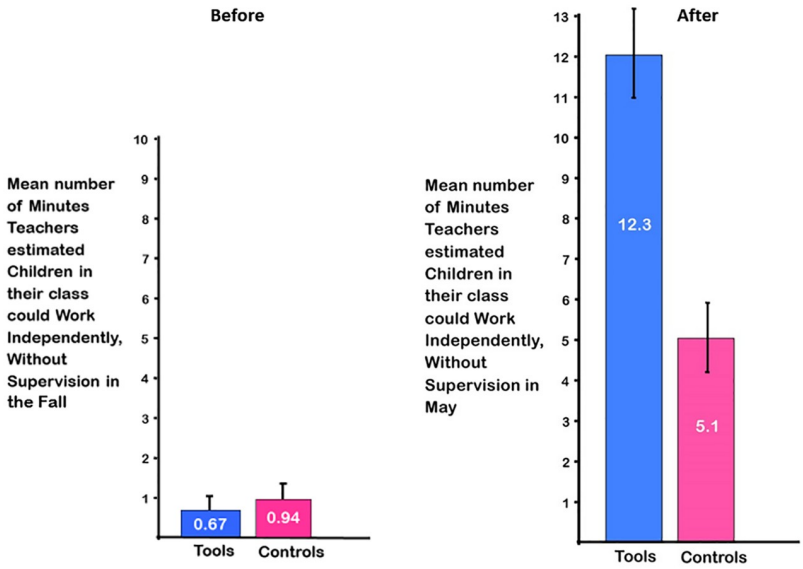

Fig 6. Ability of children to work on their own, unsupervised. By May, teachers in *Tools* felt their children could be left to work without supervision for far longer than did control teachers, although teachers' estimates of this had been comparable in the Fall.

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on task and quickly resume work after a break), markedly reduces teacher burnout and children being ostracized or excluded, and increases the joy students and teachers experience in school.

Limitations of the present study are: (1) Any new program may show benefits simply because it is new. *Tools* was new here and it was not compared to another new program but to a wait-list control group. (2) Teacher reports should be viewed cautiously because people can see what they hope and expect to see. (3) In the glow of the first year of a program, larger benefits are often seen than in subsequent years. (4) We might have had statistical power to detect group differences in math improvement or differential benefit from *Tools* in children from lower-income homes had we had more than nine classes per condition. (5) Though we had worked quite hard to match the *Tools* and non-*Tools* classes on teacher and student variables, hours of professional development, funds for materials, etc., one difference crept in unbeknownst to us: The *Tools* teachers arranged to meet together bi-monthly. It is possible that if the teachers in the control group had also met together, their results might have been better and the difference between their results and those from *Tools* less marked.

Even taking those considerations into account and therefore assuming that gains may appear larger here than they truly are, even if the true gains are half of what was observed, they are still quite impressive whether one looks at objective measures of academic performance, first-person reports of reduced teacher burnout, or teacher reports of student behavior. Results were better for *Tools* classes across most domains (reading, writing, peer inclusion, children's ability to get along with, and be kind and helpful to, one another, children's ability to work independently and stay on task without supervision, their ability to settle down quickly after a break and get back to work, teachers' renewed joy in teaching, and students' excitement about learning and joy in coming to school). The one exception was math, where results tended to be better for *Tools* classes, but not significantly so. The results were better than (a) the same teachers had in previous years and (b) control-group teachers had in the year of the study.

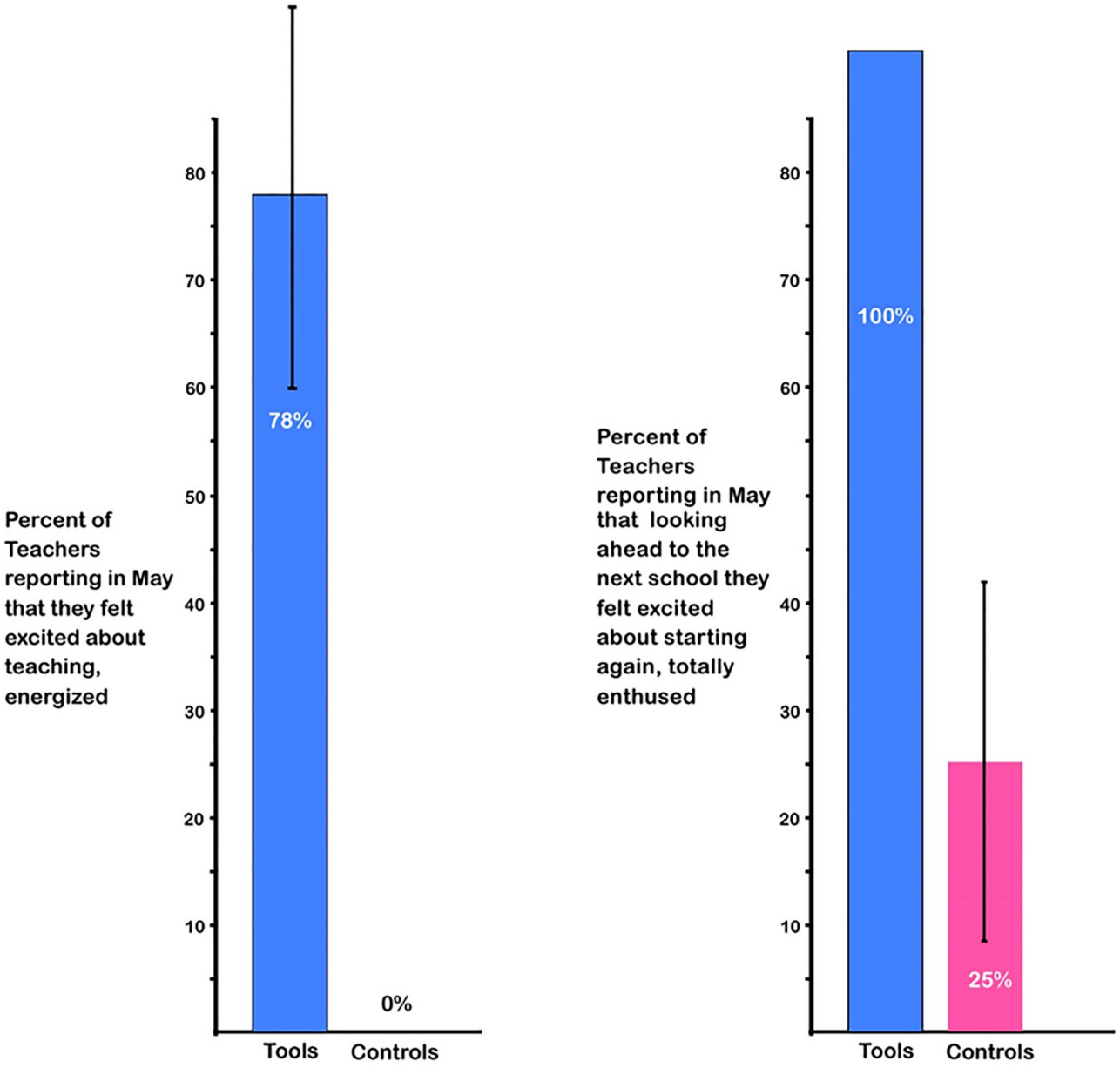

Fig 7. Teachers' feelings about Teaching. Over three-quarters of *Tools* teachers, but none of the control teachers, responded in May that they were extremely excited about teaching (choices 1 or 2 on the 10-point scale): $\chi^2(1, N = 18) = 4.99$, $p = 0.02$, odds ratio = 3.58. Similarly, *all Tools* teachers responded that they were utterly enthused and looking forward to the next school year (choices 1 or 2 on the 10-point scale), while only 2 control teachers selected choice 2: $\chi^2(1, N = 18) = 5.67$, $p < 0.02$, odds ratio = 5.86.

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The percentage of children able to write one or more self-composed sentences was almost 300% greater in *Tools* classes (63% in *Tools* versus 22% in control classes), though writing skills had been comparable in *Tools* and control classes in the Fall. Conversely, the percentage of children whose writing skills were no better than the initial sounds of words was almost 300% greater in control classes (8% in *Tools* versus 23% in control classes). *Tools* emphasized writing and control classes did not. Thus, it is not surprising that children in *Tools* showed more advanced writing than control children. *The extent* to which children in *Tools* progressed is

quite surprising, however—well beyond what anyone in BC public schools had seen previously in kindergarten children and well beyond the upper limits on the BC assessment tool for kindergarten. These results suggest that if writing is encouraged and supported in the way that *Tools* does, kindergarten children are capable of far more advanced writing than most educators and parents have assumed (and children start kindergarten 6 months younger in BC than in general in the US). (*Tools* teaches writing before reading, and being able to write is critical for recording what they plan to do in their play scenarios so children in *Tools* are highly motivated to master that. See S6 File for writing samples).

The developers of *Tools* had prioritized aligning *Tools* with Canadian learning standards and styles (this being the first implementation of *Tools* in any Canadian kindergartens) and had prioritized language skills over math skills for the first year of implementation. Thus, outcomes for language skills were markedly better for *Tools* versus control children and outcomes for math only marginally better. Importantly, math did not suffer in the *Tools* classes. There was no tradeoff with language skills being better in *Tools* classes and math skills worse. Math performance was at least as good, indeed marginally better, among children in *Tools* versus control classes.

By the end of kindergarten, *Tools* teachers estimated that their children could continue to work unsupervised for two and a half times longer than control teachers estimated for their students (12.3 versus 5.1 minutes). After breaks, 100% of children in *Tools*, but only about 50% of control children, could get back to work right away, according to teacher reports. This was echoed in marked differences between *Tools* and control classes in teachers' comments about children's self-regulation, ability to pay attention, and ability to work independently. This speaks to one of the greatest challenges voiced by Grade 1 teachers and one of their most common complaints—children's poor self-regulation and ability to pay attention. Indeed, teachers report that the task of managing the classroom can lead to high levels of stress and burnout [85]. Children's ability to pay attention when they enter Grade 1 predicts their later achievement in both math and reading [86, 87]. Children's ability to work independently is critical to teachers' ability to give individual attention to a student and for students to be able to work at different levels or follow their unique interests. Indeed, teachers mentioned that before *Tools* they had had difficulty supporting the more advanced students to move ahead of the rest.

In all control classes but one, teachers reported at least one child was likely to be left out by other children and in-group cliques had formed. In contrast, in all but two or three *Tools* classes, that was completely absent. Many control-group teachers mentioned in May that were still problems with some children hitting others or refusing to share, but that was no longer present in *Tools* classes. These findings have implications, we think, for reducing the incidence of bullying and of mental health issues in primary school.

Those large differences are particularly noteworthy because BC emphasizes educating children to be socially responsible citizens who are kind and compassionate. All teachers had this as a goal, but *Tools* enabled teachers to experience more success in realizing that goal, even though most teachers had received training in the *Second Step* social-emotional learning program and about half had received training in the *MindUp* mindfulness and social responsibility program. One would expect differences to be even greater between these *Tools* classes and classes where prosocial behavior was not a curricular priority.

Control group teachers were wait-list controls. They were looking forward to also being trained on Tools. In the meantime, during the study year, they were given the opportunity to get professional development workshops for free on whatever they wanted. They were thrilled with the three workshops they chose and much appreciated the funds we provided for new materials. There was no indication they were demoralized at not being chosen to be trained on Tools at the outset of this study.

By May, however, all teachers in the control group were indeed exhausted. *None* felt excited or energized about teaching or excited and enthused in looking ahead to teaching next year. In contrast, almost 80% of *Tools* teachers did (78% versus 0%). In part that was because the *Tools* teachers perceived their students as experiencing so much joy in school, progressing so far, and gaining so much confidence and sense of self-efficacy. Indeed, *Tools* teachers reported seeing improvements in all three core needs identified in self-determination theory [88] (increased feelings of social relatedness [community], autonomy, and perceived competence).

Economically-disadvantaged children benefited (as past studies had demonstrated, e.g. [68, 69]), but for the first time *Tools* was also tried in schools serving primarily middle and upper-middle income families. Children across the board benefitted from *Tools*–whether higher or lower socio-economic status (SES) and whether more advanced in academic skills or self-regulation at school entry or not. Outcomes did not differ significantly by teacher characteristics or children's free-lunch or ESL status.

Children in *Tools* with weaker reading skills at school entry made greater progress in reading than other children in *Tools*. (Also, while the results for reading *had* differed across *Tools* classes with more versus fewer lower-income children in the Fall ($F[1,6] = 5.74$, $p = 0.03$, $\eta p^2 = 0.24$), those differences largely *disappeared* by the Spring ($F[1,6] = 1.08$, NS). *Tools*, thus, tended to reduce initial disparities separating children, schools, and teachers. Regardless of the SES levels of students in the class, the prevalence of English-language learners, or the experience level of the teacher, by May over half the children in *Tools* were able to read and write independently. Principals and resource teachers were surprised, when they walked into *Tools* classrooms in the Spring, to be unable to identify the special needs students.

Our assessment measures did not show greater writing gains for *Tools* children from lower-SES homes than from more economically-advantaged homes ($\chi^2[1, N = 9] = 3.37$, NS). Yet, when the 2 *Tools* expert trainers from Colorado came for their Spring workshop and were given de-identified samples of the children's writing, to their surprise they were no better than chance at identifying those from low-income classes and those from middle-income ones, whereas in the Fall the differences had been stark. This suggests that while our measures did not indicate differential progress, the gap appears to have closed at least to some extent. Differences by SES were still present to be sure, but they were noticeably reduced (so much so that no significant differences remained).

Null results for *Tools* versus comparison conditions were reported at a Society for Research on Educational Effectiveness (SREE) conference [89, 90] although these have never been published in a peer-reviewed journal. At the SREE meeting, Lonigan [89] reported no differential benefit to EFs comparing preschool *Tools* to his program (*Literary Express*™). EFs were not assessed in that study, however, so the report of no difference in EFs outcomes is curious. Many of the schools in that study requested that their district adopt *Tools*; no school requested that for *Literacy Express*.

Wilson and Farran [90] reported null results from Year 1 of their study of pre-kindergarten *Tools* in Tennessee and North Carolina. Theirs was a textbook-perfect research design, but some of their outcome measures were prone to ceiling and floor effects (e.g., most 5-year-olds pass the Dimensional Change Card Sort test). One school district in the Wilson-Farran study was so impressed by the markedly better writing of *Tools* children that the district used its own funding to have all its teachers trained in *Tools*. (Assessment of writing had not been part of the research study). Other school districts that had been in the study did likewise because principals and kindergarten teachers felt they observed better social skills and readiness for learning in children who had attended *Tools* pre-kindergartens versus children from other pre-kindergartens. (The research study had not evaluated children in kindergarten, but only at the beginning and end of pre-kindergarten).

A limitation of the present study was the lack of funding to follow the children into Grade 1 and beyond, and also to include additional cohorts in teachers' second and third years of implementing *Tools*, as had been our plan. We had hoped to investigate whether similar results would be replicated with other cohorts and to investigate how long gains would last and whether they might even increase. There is much evidence of academic gains increasing over time from *Tools* and from other beneficial programs (e.g. [68, 91–94]).

One reason particularly large effects may have been found in the present study is that all teachers in both the *Tools* and control group had indicated a willingness to learn and implement *Tools*. Other studies may have assigned teachers to *Tools* who might have been disinclined to implement it, weakening their effects. Usually teacher preferences are ignored in implementation studies. But teacher preferences can exert large effects! A teacher who is opposed to a program is less likely to do a good job implementing it [95–97]. After a study documents benefits from that program, that same teacher might then willingly implement it.

There are limitations on the possible applicability of the results found here to other contexts: (1) Important differences between early education in BC and the US led the developers of *Tools* to feel that the implementation of *Tools* in BC was more developmentally appropriate and a truer implementation of the *Tools* philosophy than *Tools* in the US. Without having to worry about high-stakes standardized tests at the end of year, stress levels were lower and *Tools* could be implemented the way it was intended–following each child's lead. A particularly important difference to the developers of *Tools* was the stronger emphasis on play in BC *Tools* classrooms than in US *Tools* classrooms. In BC, children had an hour of play daily where they dramatized what they had been reading. They became deeply immersed in it, becoming the characters, and wrote about what they had learned about the lives of the people. Almost all children attained the level of intentional, mature make-believe play that Vygotskians associate with the development of self-regulation. In the US, because of the press for academics, children have only 20–30 minutes, and less as the year progresses, to dramatize stories and they do so only once a week instead of daily.

Clearly a full hour of dramatic make-believe play daily plus time each day for other types of play is not inconsistent with children doing extremely well in kindergarten, since the children in the present study did extremely well. Indeed, it is possible that copious playtime in kindergarten may be critical for laying the groundwork for academic success. This is especially noteworthy since there is enormous pressure on teachers to allow less and less time for play and devote more and more time to direct academic instruction, even in kindergarten [98, 99].

(2) Another limitation on possible generalizability is that most teachers in the present study were experienced. *Tools* is a demanding curriculum. Teachers in the present study bemoaned the amount of information to learn, e.g.: "The vast amount of materials that accompany the program is a challenge." "The most challenging thing was implementing everything in the program. Adding a few new things was okay but having to learn everything and teach all new things at once was very challenging." *Tools* may work best with teachers with at least a bachelor's education, as most teachers here had.

This study does not enable one to determine "the active ingredient" of *Tools* nor which benefits of *Tools* contribute to making other benefits possible. Our hypothesis is that *Tools* works because of the gestalt that is *Tools* and that searching for the key element would be futile and fruitless. We hypothesize that *Tools* improves EFs because it directly trains, scaffolds, and challenges them, providing numerous opportunities to practice exercising them at progressively more advanced levels, *and* because it supports them by improving emotional and social well-being. We also hypothesize that *Tools* improves academic skills by directly targeting them in ingenious ways *and* because *Tools* improves EFs and emotional and social well-being.

Most elements of Tools probably affect more than one outcome. For example, scaffolding EF skills not only helps children practice those skills at a more advanced level than they would otherwise be able, thus aiding the development of those skills, but also reduces stress in the classroom. Teachers are less worried about the children not being able to exercise self-control or attention-regulation and children are less worried about being scolded for not exercising those EF skills [76, 100]. Conversely, stress impairs self-control [101, 102] and attention-regulation [50, 103], and reducing stress aids them. Also, by scaffolds increasing the likelihood of success and reducing the incidence of failure, they help build children's self-confidence and belief in their ability to succeed [76].

Once children have a modicum of self-control and attention-regulation, that makes possible being able to work alone or with another child without the teacher needing to control the class from the front of the room. That makes possible a host of beneficial educational practices such as individualized pacing, instruction, and assessment because all the children doing the same activity together is no longer required [76, 100].

The paired play (pairing each child with every other at least once every week) not only helps each child get to know all the other children better and learn to get along with and work together with each (helping to build a sense of community), but also aids the development of language and EFs through the regulation of one another by verbal correction and feedback [80]. In Tools, each child in a pair gets to play the role of the "checker" and the one being checked, including younger children serving as the checker for older ones. The hands-on learning by working together with another child aids mastery of the academic material [76]. The improved sense of camaraderie in the classroom, which paired play facilitates, probably also aids EFs.

The clearest findings in the present study are: (a) *Tools* reinvigorated teachers' enthusiasm for teaching. Those concerned with teacher burnout should take note. Burnout is leading many teachers to leave the profession [25, 104] and it causes many who stay to have less commitment to their job and less patience with the children [24, 104, 105]. Job burnout also contributes to poor health [106, 107]. Indeed, a one-unit increase in burnout score was found to be associated with greater risk for hospital admission for mental health problems and for cardiovascular problems [107]. (b) Teachers perceived *Tools* as making a big difference and perceived far better outcomes on an array of dimensions (academics; kindness, cooperation, and helping; joy in learning) than in the past. This seems to be a consistent theme across all studies of *Tools*, even where null findings have been reported. It is unlikely that that these findings are simply a halo effect for a new curriculum, because when compared head-to-head with another new curriculum, *Literacy Express*, in the study mentioned by Lonigan (89) many teachers requested that the district adopt *Tools* but none requested that for *Literacy Express*. It may be that teachers are seeing what they want or expect to see, but in the case of Diamond et al. [69] the teachers expected the district's new program to yield better results than *Tools* and the district administration was very dismayed when it did not, since they had put so much effort into developing their new curriculum and were so proud of it. As researchers we need the humility to accept the possibility that teachers are picking up on things our assessment tools might be missing.

(c) *Tools* markedly improved reading and writing and these findings provide an existence proof that kindergarten children can write at more advanced levels than most had thought–composing sentences of their own creation with advanced vocabulary (e.g., stalagmites and stalactites). *Tools* teachers in the study said that their experience this year had changed their expectations of what kindergarten children could accomplish, e.g., "Children in kindergarten are capable of so much more than I imagined." This occurred despite–or perhaps because of–carving out an hour a day for social dramatic play, encouraging other forms of play, and

spending as much time on social-emotional growth as on academic growth. Clearly there is no indication whatsoever that play or social emotional learning interfered in any way with academic progress, and might well have aided it.

The findings of the study have relevance to several issues of keen scientific and societal interest: reducing the epidemics of bullying and teacher burnout, increasing student engagement in school, improving academic outcomes, and reducing socioeconomic inequalities in academic performance and EFs.

Supporting information

S1 File. *Tools* Brochure.
(PDF)

S2 File. BC's kindergarten assessment tools.
(PDF)

S3 File. Survey monkey teacher questions.
(PDF)

S4 File. Table 3. All Dependent Measures analyzed, with Subsidized lunch, ESL, and Years Teaching as Covariates.
(DOCX)

S5 File. Comments by teachers, parents, and principals.
(PDF)

S6 File. Two writing samples.
(PDF)

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Supervision: Adele Diamond.

Visualization: Adele Diamond, Chris Lee, Peter Senften, Andrea Lam, David Abbott.

Writing – original draft: Adele Diamond.

Writing – review & editing: Adele Diamond, Chris Lee, Peter Senften, Andrea Lam, David Abbott.

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S4 – Table
All Dependent Measures analyzed,
with Subsidized Lunch, English as a Second Language (ESL), and Years Teaching as Covariates

Dependent Variable	Analyses controlling for % receiving Subsidized Lunch, centered	Analyses controlling for % ESL, centered	Analyses controlling for Years of Teaching, centered
Comparing children's improvement in reading over the kindergarten year in *Tools* classes vs. in Control classes			
Improvement in Reading	$\chi^2(1, N = 18) = 4.64$, $p = 0.02$, odds ratio = 3.25 Covariate: $p = 0.03$	$\chi^2(1, N = 18) = 4.72$, $p = 0.02$, odds ratio = 3.30 Covariate: $p = 0.03$	$\chi^2(1, N = 18) = 4.30$, $p = 0.03$, odds ratio = 3.05 Covariate: $p = 0.22$
Comparing the percentage of children who were reading at Grade 1 level or better by May in *Tools* classes vs. in Control classes			
% Reading at ≥ Grade 1 level	$F(1,15) = 6.67$, $p < 0.02$, $\eta p^2 = 0.33$ Covariate: $p = 0.13$	$F(1,15) = 6.43$, $p < 0.02$, $\eta p^2 = 0.32$ Covariate: $p = 0.38$	$F(1,15) = 4.39$, $p = 0.05$, $\eta p^2 = 0.24$ Covariate: $p = 0.67$
Comparing the percentage of children who were still non-readers by May in *Tools* classes vs. in Control classes			
% Non-readers	$F(1,15) = 6.02$, $p = 0.02$, $\eta p^2 = 0.29$ Covariate: $p = 0.05$	$F(1,15) = 5.31$, $p < 0.05$, $\eta p^2 = 0.27$ Covariate: $p = 0.08$	$F(1,15) = 4.76$, $p < 0.05$, $\eta p^2 = 0.26$ Covariate: $p = 0.80$
In *Tools* classes only, comparing improvement in reading over the kindergarten year by lower-income children vs. those more economically advantaged.			
Improvement in Reading: Lower vs. Higher SES; *Tools* classes only	n/a	$\chi^2(1, N = 9) = 4.17$, $p = 0.12$ [NS], odds ratio = 2.05 Covariate: $p = 0.63$	$\chi^2(1, N = 9) = 4.28$, $p = 0.11$ [NS], odds ratio = 2.11 Covariate: $p = 0.26$
In *Tools* classes only, comparing improvement in reading over the kindergarten year by how far along the children were in reading in September (regression of change in reading level on initial reading level)*			
Improvement in Reading by Initial Reading Level; *Tools* only	$F(2,6) = 18.18$, $p < 0.005$, $R^2 = 0.89$ Covariate: $p = 0.72$	$F(2,6) = 11.61$, $p < 0.01$, $R^2 = 0.80$ Covariate: $p = 0.62$	$F(2,6) = 11.64$, $p < 0.01$, $R^2 = 0.80$ Covariate: $p = 0.38$
Comparing children's improvement in writing over the kindergarten year in *Tools* classes vs. in Control classes			
Improvement in Writing	$\chi^2(1, N = 18) = 20.20$, $p < 0.001$, odds ratio = 26.18 Covariate: $p = 0.25$	$\chi^2(1, N = 18) = 19.90$, $p < 0.001$, odds ratio = 26.01 Covariate: $p = 0.32$	$\chi^2(1, N = 18) = 19.05$, $p < 0.001$, odds ratio = 25.50 Covariate: $p = 0.87$
Comparing the percentage of children able to write a sentence or consecutive ones they themselves composed with most sounds represented in *Tools* classes vs. in Controls classes			

% able to write an original sentence or consecutive ones	$F(1,15) = 18.10$, $p < 0.001$, $\eta p^2 = 0.55$ Covariate: $p = 0.47$	$F(1,15) = 18.24$, $p < 0.001$, $\eta p^2 = 0.55$ Covariate: $p = 0.29$	$F(1,15) = 16.43$, $p < 0.001$, $\eta p^2 = 0.52$ Covariate: $p = 0.98$
Comparing the percentage of children able to write $\geq$ 1 sentences they composed with most sounds represented in classes taught by the teachers assigned to *Tools* in the year before Tools was implemented vs. Year 1 of *Tools*			
% able to write $\geq$ 1 original sentences the year before *Tools* vs. Yr 1 of *Tools* (same teachers both years)	$\chi^2(1, N = 8) = 13.54$, $p < 0.01$, odds ratio = 9.42 (Data were available for 8 of the 9 Tools teachers because for one *Tools* teacher, Year 1 of *Tools* was her first year teaching. Data on subsidized-lunch and ESL status were not available for the pre-*Tools* year at the class level. Teacher's years of experience was completely confounded with pre-*Tools* year versus Year 1 of *Tools* in this within-teacher comparison.)		
In *Tools* classes only, comparing improvement in writing over the kindergarten year by lower-income children vs. those more economically advantaged.			
Improvement in Writing: Lower vs. Higher SES; *Tools* classes only	n/a	$\chi^2[1, N = 9] = 3.37$, $p = 0.17$ [NS] odds ratio = 1.83 Covariate: $p = 0.25$	$\chi^2[1, N = 9] = 2.66$, $p > 0.20$ [NS] odds ratio = 1.24 Covariate: $p = 0.83$
Comparing children's improvement in math over the kindergarten year in *Tools* classes vs. in Control classes			
Improvement in Math	$\chi^2(1, N = 18) = 2.50$, $p = 0.11$ [NS], odds ratio = 1.56 Covariate: $p = 0.45$	$\chi^2(1, N = 18) = 2.54$, $p = 0.11$ [NS], odds ratio = 1.56 Covariate: $p = 0.42$	$\chi^2(1, N = 18) = 1.50$, $p > 0.20$ [NS], odds ratio = 1.12 Covariate: $p = 0.64$
Comparing the percentage of children in May who could do no better than count up to 20 objects			
% able to do no better than count up to 20 objects	$F(1,15) = 3.16$, $p = 0.10$ [NS], $\eta p^2 = 0.17$ Covariate: $p = 0.39$	$F(1,15) = 2.68$, $p = 0.12$ [NS], $\eta p^2 = 0.15$ Covariate: $p = 0.59$	$F(1,15) = 2.62$, $p = 0.13$ [NS], $\eta p^2 = 0.03$ Covariate: $p = 0.49$
Comparing the percentage of children in May who could do simple subtraction in *Tools* classes vs. in Control classes			
% able to do simple subtraction	$F(1,15) = 1.77$, $p = 0.20$ [NS], $\eta p^2 = 0.11$ Covariate: $p = 0.56$	$F(1,15) = 1.94$, $p = 0.18$ [NS], $\eta p^2 = 0.11$ Covariate: $p = 0.47$	$F(1,15) = 1.88$, $p = 0.19$ [NS], $\eta p^2 = 0.11$ Covariate: $p = 0.46$
Comparing the percentage of children in May reported to be having problems interacting with other children in *Tools* vs. Control classes			
Problems interacting with other children	$F(1,15) = 6.83$, $p < 0.02$, $\eta p^2 = 0.31$ Covariate: $p = 0.51$	$F(1,15) = 6.37$, $p = 0.02$, $\eta p^2 = 0.30$ Covariate: $p = 0.59$	$F(1,15) = 6.06$, $p = 0.02$, $\eta p^2 = 0.29$ Covariate: $p = 0.99$
Comparing the change from Sept. to May in the percentage of children reported to be having problems interacting with other children in *Tools* vs. Control classes			
Change in % having problems interacting with other children	$F(1,15) = 20.59$, $p < 0.001$, partial eta squared = 0.58 Covariate: $p=0.007$	$F(1,15) = 15.81$, $p < 0.001$, partial eta squared = 0.51 Covariate: $p=0.004$	$F(1,15) = 15.13$, $p < 0.001$, partial eta squared = 0.50 Covariate: $p=0.06$

Comparing whether or not the teacher noticed any cliques in May in *Tools* classes vs. in Control classes			
Presence of ≥ 1 Clique	$\chi^2(1, N = 18) = 11.99, p < 0.001$, odds ratio = 15.77 Covariate: $p < 0.001$	$\chi^2(1, N = 18) = 6.48, p < 0.01$, odds ratio = 7.72 Covariate: $p = 0.35$	$\chi^2(1, N = 18) = 6.01, p = 0.01$, odds ratio = 7.11 Covariate: $p = 0.60$
Comparing whether or not the teacher noticed any child who tended to be ostracized or left out in *Tools* vs. Control classes in May			
Presence of ≥ 1 ostracized or left-out child	$\chi^2(1, N = 18) = 4.87, p = 0.02$, odds ratio = 3.45 Covariate: $p = 0.53$	$\chi^2(1, N = 18) = 6.63, p < 0.01$, odds ratio = 8.30 Covariate: $p = 0.53$	$\chi^2(1, N = 18) = 3.21, p = 0.07$ [NS], odds ratio = 2.2 Covariate: $p = 0.64$
Comparing whether or not the teacher reported students were good at getting back to work after recess and weekends in *Tools* classes vs. in Control classes in May			
Getting back to work after recess and weekends	$\chi^2(1, N = 18) = 5.31, p < 0.02$, odds ratio = 5.28 Covariate: $p = 0.46$	$\chi^2(1, N = 18) = 5.04, p = 0.02$, odds ratio = 5.04 Covariate: $p = 0.42$	$\chi^2(1, N = 18) = 6.69, p < 0.01$, odds ratio = 8.39 Covariate: $p = 0.13$
Comparing whether the teacher reported students had been good at getting back to work after Spring break in *Tools* vs. Control classes			
Ability to get back to work after Spr. break	$\chi^2(1, N = 18) = 4.92, p = 0.02$, odds ratio = 3.50 Covariate: $p = 0.13$	$\chi^2(1, N = 18) = 4.33, p < 0.03$, odds ratio = 3.05 Covariate: $p = 0.61$	$\chi^2(1, N = 18) = 3.81, p = 0.05$, odds ratio = 2.6 Covariate: $p = 0.90$
Comparing # of minutes teachers reported their students could be left to work on their own, unsupervised, in *Tools* vs. Control classes in May			
# of minutes could work unsupervised	$F(1,15) = 11.43, p < 0.005, \eta p^2 = 0.43$ Covariate: $p = 0.76$	$F(1,15) = 14.98, p < 0.005, \eta p^2 = 0.50$ Covariate: $p = 0.04$	$F(1,15) = 12.96, p < 0.005, \eta p^2 = 0.46$ Covariate: $p=0.32$
Comparing *Tools* and control teachers' excitement about teaching in May. (Because the distributions were so skewed, we compared the % endorsing choices 1 or 2 (excited about teaching, energized) to the % endorsing any other choice on the 10-point scale.)			
Teachers' excitement about teaching in May	$\chi^2(1, N = 18) = 4.99, p = 0.02$, odds ratio = 3.58 Covariate: $p = 0.71$	$\chi^2(1, N = 18) = 4.29, p < 0.03$, odds ratio = 3.00 Covariate: $p = 0.27$	$\chi^2(1, N = 18) = 4.26, p < 0.03$, odds ratio = 3.00 Covariate: $p = 0.37$
Comparing *Tools* and control teachers' enthusiasm in looking forward to the next school year. (Because the distributions were so skewed, we compared the % endorsing choices 1 or 2 (extremely enthused) to the % endorsing any other choice on the 10-point scale.)			
Teachers' enthusiasm looking forward to the next school yr	$\chi^2(1, N = 18) = 5.67, p < 0.02$, odds ratio = 5.86 Covariate: $p = 0.73$	$\chi^2(1, N = 18) = 7.71, p < 0.01$, odds ratio = 10.86 Covariate: $p = 0.25$	$\chi^2(1, N = 18) = 5.67, p < 0.02$, odds ratio = 5.86 Covariate: $p = 0.02$

* We would have done a similar analysis for writing and for math but there was too little variation between children in the Fall levels of writing or math competence.

Gray font indicates non-significant results.

ηp^2 = partial eta squared

χ^2 indicates a generalized estimating equation analysis was used, from which a chi square was generated.

S5 - Comments by Teachers, Parents, and Principals

The topics covered here are:

- **General**
- **Reading**
- **Vocabulary and Oral Language**
- **Writing**
- **Math**
- **Getting Along Together; Lack of Fighting and Social Exclusion**
- **Children Helping and Supporting One Another**
- **Sense of Community in the Classroom**
- **Ability to Work Independently**
- **Self-Regulation / Attention Regulation**
- **Joy in Learning and Enjoyment of School**
- **Teachers' Feelings about Teaching**

General Comments

Tools teachers

"I see the positive outcomes for my students in all aspects of their learning! This really is making a difference!"

Control-group teachers

Parents

Parent #1: "I cannot speak highly enough of the Tools of the Mind program. My son has developed and matured so profoundly since the beginning of the school year that is difficult to summarize in a few sentences.

I have watched him become excited and continually interested about learning everything. He began the year with little interest in reading or imaginative play. Now he tells his father and I a chapter in his 'story' (a book he is writing in his head) every night. He guides his 3 year old sister and friends outside of school in imaginative play and storytelling. He wants to read chapter books and is determined to finish reading/hearing the Treehouse series of books. He has come home and asked to do 'homework', taking time each day to practice his skills by doing mazes, coloring, working on letters or trying math. All this is self-directed. At the beginning of the year it was difficult to even get him to sit for 5 minutes to color a page and now he readily takes responsibility for himself and his actions.

This program has gone a long way towards instilling my child with exceptional abilities that will take him through life inside and outside of school. As a mom I have the best intentions of working on my children's learning outside of school but in this busy ol' world reality and intention don't always work together. I have found that the way my son is taking control of himself has made it much easier to create support for him at home. It discourages helicopter parenting in the best possible way. At 5 years old I see skills growing in him that I sadly find missing in people 15 or more years his senior. This is a wonderful program and the effects have been profound and astounding in our lives. I sincerely hope that, when the time comes, I will be able to have my daughter in the Tools of the Mind program so that she will have the same significant start in school and learning as my son."

Parent #2: "Below are some thoughts on Tools of the Mind. How do you sum up such a great program in a few words??? I am writing as a parent of a Kindergarten student who is part of the Tools of the Mind Program. I have also had the opportunity to volunteer regularly in the classroom and observe the progress that the children are making. Without exception, the children in the class have enthusiastically embraced each of the different themes presented and have eagerly anticipated each new book being introduced. Their enthusiasm for the materials has carried over to their play centres in the classroom where they have used the themes effectively in their free play.

I have observed students incorporating writing into their play centres through the use of white boards and notebooks. Writing is not a chore for them but something that they embrace and incorporate as part of their free play. They also use the themes for dramatic play outside at recess. All of this is student-led with roles and characters being discussed and negotiated as they leave the classroom on their way outside. Their written and verbal literacy skills have improved a great deal since the beginning of the year but so has their ability to negotiate and find solutions to problems without the need for an adult to assist. They are able to recognize their differences, accept them and find a solution where required.

In terms of my own child's progress, it is wonderful to see how he embraces learning and looks forward to being in the class each day. Learning to read has been a fast and painless process as he is able to sound out letters and figure word sounds out on his own for the most part. It has required very little parental input and it is amazing to see him reading full books when he was just beginning to sound out three letter words at the beginning of the year. His written sentences are legible, appropriate to the context and his oral story telling abilities are astounding."

Parent #3: "My child has had the privilege of attending a Tools of the Mind Kindergarten class this year. As a parent and educator, I have observed such wonderful social, emotional and intellectual growth within my child's development. As a parent, I have observed [my child's]:

* **willingness to take risks and try new things** as a learner flourish
* increasing **ability to focus** for longer periods of time on more challenging tasks
* **excitement for reading** grow. She not only loves listening to stories, but has recently been bitten by the "reading bug." [My child] will spend her free time independently reading simple patterned stories without any encouragement from adults.
* **confidence grow as a developing writer.** She confidently prints letter sounds, draws detailed pictures and enthusiastically shares her stories with her family. She considers herself a writer.
* **enthusiasm towards school.** She always has a story to share about her day and is always excited about going to school.
* **sense of belonging and relationships grow between her and her classmates.** [My child] often talks about the children she has worked with within her group and has become acquainted with **all** of the children within her class. She often shares stories about a variety of children she plays with at school.

Above all, I have noticed [my child's] excitement for learning and her inquisitive nature continue to develop. As a family, we all love listening to her share her stories "Mommy, Daddy, and Megan did you know that…"

My older son had the same teacher last year before the Tools of the Mind program was introduced. I sometimes find it hard to believe it is the same classroom with the same teacher as the entire feel of the class has changed. She is still the same amazing teacher as before but the students have so much more self control. They take an active role in the classroom and in their learning and are able to self regulate to a degree that adult intervention is rarely required."

Parent #4: "My daughter rushes out of school full of excitement about Jack and Annie [characters in the storybooks they have been reading], what they're doing, what will happen next, and she details for me all that she's learning [in Tools of the Mind].

Right up until Spring Break, the children were regularly playing "Jack and Annie" outside the classroom; at lunch, after school, on playdates. I also think they connected socially on a different level because of the activities in the classroom. She's happily playing with kids that she wouldn't have played with last year, and their play feels free

to me. Their play is wonderfully creative. In the fall, many of the girls (and some of the boys) engaged in an ongoing imaginative game about "turtle island" where they used the sandy playground to draw out a hotel ("turtle hotel") with rooms for each, and a track (for [my daughter] to run), and a kitchen. The game went on for weeks and was more creative and generative than I've really ever seen on the playground before.

The integration of fictional characters with factual information has really expanded her range of interests. She pursues additional knowledge in areas that really pique her interest. She brought home library books about the rainforest and animals you would find there when they were doing the rainforest book [remember she is in Kindergarten!], and she continuously makes connections between what we might be doing in our day and what she's learned at school. Our family really enjoys fiction, so I like seeing that her comfort with different genres of books has also increased.

The quality of the children's art is surprising in that all children are really producing amazing work—detailed and bright—perhaps because much of the art is linked to the learning that excites them. My daughter not only wanted me to admire the mummy's mask she made, but she wanted to explain to me what it was and all the death rituals of ancient Egyptians. The effort and time she and a friend put into a dragon (for Chinese New Year) and on figuring out how to draw a horse for a farm was inspiring. They started the work in school, but brought it home to finish—again, so excited and inspired by what they are doing and exposed too.

I also credit the program with encouraging her to challenge herself. She's clearly inspired by what she can find in books and happily picks up books beyond her year level. What's interesting to watch is that she is applying strategies she's learned, and it's expanding her capacity. It's not that I feel any desire for her to be reading above grade-level. The point is that she sees learning as something accessible to her. She's excited to learn and doesn't identify barriers; she just tries to overcome them.

This program has made me realize that our standards, or expectations, for what children can achieve are limiting and restrictive. In an environment that creates excitement AND skill development, children willingly investigate concepts and learn. My daughter has at least. In my opinion, she is exploring knowledge for its own sake, uncovering and engaging with ideas, and enjoying herself. Yes, she's working, but it's so joyful that I just wish she could keep going in this kind of approach throughout her K-3 schooling."

Principals

"[The Tools teacher in my school] is a very experienced, extremely talented teacher. For her to say Tools is making a difference for kids is quite something because everything she does makes a difference. She has some new "tools" and is telling me she is getting better results than ever before."

The 2 Coaches of *Tools of the Mind* teachers

"Working with the Tools of the Mind teachers has been a joy. It is amazing to see teachers who were hesitant at first to take on an extensive program gain momentum the more they learned about Tools and the more they saw results in their classrooms. Teachers tell us over and over that they are amazed at what their children have accomplished and how the program is so seamlessly interconnected in math, science, art and language. It creates a learning context familiar to the children where they can explore academics rather than receive knowledge from the top down. As the year has progressed, teacher's enthusiasm has grown with their knowledge of the program and the capability of the children."

Comments on READING

(A few comments are partially repeated under Writing, as they apply to both.)

Tools teachers

"The literacy level in the classroom this year is much higher [than in past years]. We are a new Early Intervention

school so our resource teacher evaluates all the Kindergarten children. In January, no one in my classroom was at risk. That has never happened before. Children who had qualified for ELL [English Language Learner] support at the beginning of the year, no longer qualified in January. That has never happened before. In past years some children were always at risk."

"I have never had a whole class that was reading by May until I did the Tools program. Students are reading many sight words and are able to use all of the strategies for reading that we practice everyday.

"Students are not only able to read (for the most part) but they enjoy it and WANT to do it!!! They also feel such a great sense of pride being able to do it."

"Only 6 children in my class are NOT reading this year. In past years I was lucky to have 6 kids who *were* reading. As of Feb, I had 17/22 students reading at a DRA Level 3, including ELL students – exceeding expectations. As of April, the majority of my students are reading at a DRA Level 6 or above, fully meeting criteria for the first term of Grade 1."

"Normally I only get to A level books with most students (possibly a few to B) but this year I have students reading A-C levels so far."

"Much higher levels of reading and writing for every child [than in past years]. Opportunities for those children who come to school with knowing how to read and write to continue to grow."

"Starting to read in kindergarten is so amazing!!"

"Much higher levels of reading and writing for every child. Opportunities for those children who come to school knowing how to read and write to continue to grow."

Control-group teachers

"The majority of my class know all their letters and sounds. Some are beginning to sound out words. I have four students who are able to read some sight words. I have four students who do not yet know their letters and sounds."

"This year I observe that there are more readers in the classroom than in past years. A lot of work has been done in the area of literacy development. Reading is one of the school goals and this year is the first year our school has received early intervention funding/support."

"Most children can recognize many word families and some sight words, though they can't read a book. I also directly teach phonemic awareness, and administer the ELPATS (a phonemic awareness assessment) and about 80% are not at risk."

Parents of children in *Tools of the Mind*

"Since the beginning of the school year I have noticed a huge change in my son's confidence in reading words. He also writes sentences at home and can explain concepts."

"This is my first experience with a child in Kindergarden so I was not sure what to expect for [our second child] this year. I have been so impressed with what he has achieved. He can sound out and recognize words with increasing frequency; I didn't expect him to be so close to reading at this stage."

"Learning to read has been a fast and painless process as he is able to sound out letters and figure word sounds out on his own for the most part. It has required very little parental input and it is amazing to see him reading full books when he was just beginning to sound out three letter words at the beginning of the year."

"I credit the program with encouraging her to challenge herself. She's clearly inspired by what she can find in books and happily picks up books beyond her year level. What's interesting to watch is that she is applying strategies she's learned, and it's expanding her capacity. It's not that I feel any desire for her to be reading above grade level. The point is that she sees learning as something accessible to her. She's excited to learn and doesn't identify barriers; she just tries to overcome them."

Coach of *Tools of the Mind* teachers

"This method of teaching writing has enabled the children to understand how words and sounds function and they have naturally moved into reading. With the emphasis on helping children learn to write, we see many more children able to read and write….The program accommodates students of all levels so they are stretched whatever their ability."

One of the two creators of *Tools of the Mind*

"It is really, really exciting that we got high literacy scores without pushing but 'following the children's lead' so that children were taught skills when we knew they were ready for them. This shows that teaching reading in a developmentally appropriate way that is responsive to the children can get the same or better results. At no point were children forced to read – and Tools teachers never did phonics drills. I think it is important that these literacy gains are *completely* without teacher-led drills on letters or sounds."

Comments on VOCABULARY and ORAL LANGUAGE

Tools teachers

"All the students are speaking with far richer vocabulary with each other now than at the beginning of the year.

"It is amazing to see how much oral language is being used on a daily basis. They are quick to experiment with new vocabulary. They love to talk and interact with each other as they play, as they eat, and as they work."

"Children use rich, theme-related vocabulary in proper context. They also extend this language out on the playground, and in other discussions. They make many connections with various texts and real world situations."

"The language in our classroom is very rich! They love having discussions about the topics we are learning about and the students are so excited about the topics that they go home and do even more research. Plus students are always surprising me with connections they have made between topics and books we have already read in class.

"There is lots of conversation which is on topic and connected to our themes."

"I see more conversations and negotiating with each other."

"Children use oral language skills to solve their problems. They use the vocabulary in their dramatization. And it is amazing to see how much oral language is being used on a daily basis. They are quick to experiment with new vocabulary. They love to talk and interact with each other as a play, as they eat, and as they work."

"They are able to articulate what they are working on and know how to get there."

Control-group teachers

"Their phonemic skills have increased immensely, and their oral language has increased as well (especially in social play). I mostly notice them using vocabulary from the science texts we read."

"Most of my students have excellent verbal skills."

Comments on WRITING

(A few comments are partially provided above under Reading, as they apply to both.)

Tools teachers

"The writing my students produce is personal and meaningful. Even days later they can re-tell what they have written. This had never occurred in any of my kindergarten classes before….The children's writing is constantly

improving and they strive to write more. They want to write, they want to be heard, and they transfer this skill set in to other areas of their lives."

"Writing growth is profound. My ESL resource teacher has never seen such growth of Kindergarten students in her entire teaching career. (She is close to retirement.) Every child is excited to write – even the weaker students who are happy to ask for help."

"In my classroom 20/22 children are able to write at least beginning sounds to represent what they have written and are able to remember and re-read what they have written even days later. In previous years, only a few of my students could write a message and be able to re-read what they had written even on the same day."

"Writing has come so far in the majority of students. They are not restrained by a frame or inability to write a word, they can get a message in their mind, remember it, write lines to represent and add letters/sounds. They can write what they want and they can (with big vocabulary words and detail) – it is empowering for them!... This is the first time in my 6 years as a primary teacher that 17/20 of my students are meeting or exceeding grade level expectations for writing. I have students writing and sustaining focus… the program has really helped learners who would have struggled much more."

"Amazing writing development. Some kindergarten children are writing up to 3 sentences (some even more) which is very exciting. My students are now confident writers."

"Writing like I've never seen before! I have 2/3 of my class writing meaningful sentences – 1/3 of those are actually writing multiple sentences. The remaining 1/3, who are not yet writing sentences, understand the process of writing and are beginning to fill their lines with initial and end sounds."

"The literacy level in the classroom this year is much higher. We are a new Early Intervention school …. This year I find that every child in my class can write a sentence by themselves. More children than ever before are able to write more than expected. It has been very rewarding and exciting to see. It is also exciting to read chapter books to the students. The topics in the books really make learning exciting for the students. There is rarely anyone who complains that they don't know what to write. Compared to previous years in which students had a lot of trouble thinking of ideas to write and it was like pulling teeth to get them excited for writing time. <u>At this time of the year, I have never [in 20 years of teaching] seen such growth in writing nor as many students exceeding writing expectations</u>. Never dreamt I`d see kindergarten children writing full sentences, much less most of the children doing so."

"This year I have a greater % of students writing and <u>wanting to</u> write. Their output is meaningful and it shows them using their "tools" as a writer and a learner. This of course has transferred into an ability for and desire to read – I am so confident in the students I am sending to Grade one! ☺"

"Much higher levels of reading and writing for every child [than in past years]. Opportunities for those children who come to school knowing how to read and write to continue to grow. Even the lowest child who is a beginner ELL student has shown growth in being able to formulate a message that has something to do with what we have been reading and a picture to go with his writing."

"I am extremely impressed with all of our kids' ability to write. We are an inner-city school with many (almost half) at-risk. Our lowest-performing child (who is awaiting a Ministry designation) who was unable to orally put a sentence together was able to tell me yesterday that "the" is spelled "T-H-E". This is HUGE!"

"The students' writing and reading is amazing! An LST [Learning Support Teacher] came to look at one of my lower students' written output. When she saw his writing she wondered why I had concerns. So I showed her the work from other students, including my ELL students and an English language learner with speech issues; she was amazed at how well and fast the entire class was progressing and quickly realized why I had concerns."

"I have enjoyed seeing the enormous progress my students have made in writing and reading. I have never had so many students writing 2 or 3 sentences by the end of Kindergarten. And all of my students are able to write at least one sentence independently with most of the sounds."

Control-group teachers (only one commented on writing)

"Writing has been a focus area and I observe a higher number of children engaging in some form of writing independently."

Resource teacher

"I am amazed at the quality and level of writing in the Tools kindergarten class I have been servicing. The sound maps are amazing!!! Because I service all 3 kindergarten classes in our school I am well aware of the differences in each class in terms of writing."

Parent of a child in *Tools of the Mind*

"Writing is not a chore for them but something that they embrace and incorporate as part of their free play."

Principals

"The writing that comes out of the Kindergarteners in Tools is amazing."

"I have noticed in our Tools class that all the children are so focused on their writing during journal time. They are very 'engaged' in their writing."

The 2 coaches of *Tools of the Mind* teachers

"We have observed that "Scaffolded Writing," the unique way writing is taught to the kindergarten children in the Tools classrooms, is having a very positive effect on their progress in this area. Most children were not writing in September but by May all but a few are. There are a number who can write two to three sentences on their own using complex sentence structure, sophisticated vocabulary and conventional spelling. There are only a handful of students in each class who are at the beginning stages of writing only the beginning sounds. These results are consistent across all socio-economic areas. We have never seen such advanced writing in Kindergarten before."

Comments on MATH

Tools teachers

"Students this year understand the concepts behind the math. It has given them a solid foundation to build upon."

"Students have asked to play math games from class at home."

"The games are engaging and the students are able to 'play' independently and they are developing key early numeracy skills. There are so many activities interwoven through the days in a variety of ways. My students love the various pattern activities with sounds and movements."

"Children are counting with increased confidence forwards and backwards."

"I'm not sure if the math is any different as a result of this program."

Control-group teachers

"I really appreciated the proD from the summer--I have used the concepts I learned in the math workshop throughout the year and it has helped immensely."

"I feel this year I have really improved in my numeracy teaching (thank you for the Math ProD workshop) and the children have a stronger number sense than in previous years."

Comments re: GETTING ALONG TOGETHER; LACK OF FIGHTING and SOCIAL EXCLUSION

Tools teachers

"There have been less issues that have come to my attention from the lunch supervisors [this year] because my students have a plan before they go out to the play. I will often hear them say things like, 'Let's play hospital. I'm the ambulance driver. You can be the sick person.' My students seem to be much better at negotiating with each other."

"The students are speaking to each other more, independently able to work through disagreements and solve problems with their peers through compromise and negotiation….They are willing to work and help any peer in the classroom. There are able to solve disagreements quite independently and there is way less tattling behaviours that used to take up a great deal of class time after recess and lunch breaks."

"I notice of course the children's preferences for friends to play with and sometimes small conflicts arise. However, this year I have been very impressed with students' abilities to work with everyone in their different groupings and I notice how supportive they are of each other."

"More willingness to interact with anyone this year. Every student is willing to work/play with any peer in the classroom vs. previous years when there were 'popular' vs. 'unpopular' problems and kids who didn't fit in."

"I have NO refusals to work with each other (regardless of ability, gender, age, culture, special needs). That would have been unheard of in past years."

"No one makes faces or puts up a fight when I partner students together. They seem more accepting of working with everyone in the classroom [than in past years]."

"Students' understanding and practice of social 'rules' is much improved. They take Tools into free play. I have had students ask me if they can remove themselves from the classroom to discuss their problem and come to a solution. Then they come back to me and tell me that they have fixed the problem. This is amazing!"

"I love hearing the children using the dispute bag to figure out who goes first and many of the skills that have been taught. They independently use these skills and don't often have to be reminded by the teacher. They are quick to share with others, those who may be new to our classroom, on the rules and expectations of our classroom. They 'help' the visitors follow our classroom rules. One of the class' favorite themes was the theme of Ninjas. The other kindergarten teacher asked me if my children were fighting outside on the playground at recess because of the ninjas. I said no. The children knew that the ninjas were in control of their bodies and that's what they wanted to do as well."

"I love the positive social interactions I see between the students. Students are able to work together with peers more effectively; there are less conflicts within the classroom between students. The students are willing to try new centres and choose to work with a variety of peers during free play."

"Students are more willing to work out disagreements and make compromises as well as help peers who need help. Students are willing to share their feelings more openly in a group setting and work together to find solutions and willing to revisit if it doesn't work and try something new. They are able to negotiate tasks and do it fairly."

Control-group teachers

"I still have children [in May] who have difficulty interacting. The kinds of negative interactions I see are: Mean statements -withholding of items or information (not sharing) - hitting, grabbing, pushing - name calling - bossy - not including others in play - refusal to be paired up with a child - taking something from someone else - defiance towards the teacher or another child - teasing - running away from a peer who wants to join in the play - laughing at another's expense - purposely bothering another (i.e. rubbing their head, taking their shoe away)."

"At this point [early May], social blackmailing continues to be an issue, as well as hitting (between the same girls who have social difficulties)."

"I find that since we have come back from spring break my students behaviour has regressed. At the beginning

of the year they didn't know 'the rules', and now they seem to have forgotten all about them again!! I am having to constantly monitor behaviour and 'put out fires'. Maybe I'm just too tired and its affecting my perspective on things!... I think that it is ridiculous that I have to send my kindergarten students out on a poorly supervised playground with 400 other students. I feel that this has resulted in increased behaviour issues both in and out of the classroom."

"Sadly, although there have been improvements, I would have to say I still have 9 children who are having difficulty interacting (e.g., refusal to share, tantrums). The physical aspects towards others have been reduced (e.g., less hitting, slapping, kicking, stealing, throwing furniture, breaking classroom supplies, hair pulling, etc.)"

"At the beginning of the year, the students needed a lot of help problem solving, and playing with more than one friend. Now students are needing less prompting when expressing their feelings to friends. They still need lots of help to negotiate play."

"The classroom is quite diverse….4 children have great difficulty self-regulating and controlling their actions/impulses and or behaviour."

"I would stay that many more than 5 of my students who have difficulty interacting - defiance towards adults, physical agression towards adults, fighting (both physically and verbally), name calling, taking something from other children, taking things from the teacher/classroom, refusing to be paired with another child either for work or play, and many other negative behaviours….Although as I mentioned, I have many students with behaviour challenges, I have many well-adjusted, thoughtful and ready to learn students in my class this year."

"At this time in the year [May] many students need mediated support to be respectful of one another's differences, to include others in their play, to advocate for their needs and to respect their peers' needs."

"Still see some defiance toward teacher and SSW, and hitting of other children."

"I am very interested in helping students to master their ability to self-regulate their thoughts, actions and behaviours and in supporting them to become kind, generous, and considerate people who have an awareness of their needs and the needs of others. I am also very interested in how to help students to realize their strengths and to use their strengths to work on areas of challenge in both themselves and others. The pace of my Kindergarteners' day is VERY fast and I would love to slow this down and give more time to self-reflection, contemplation, drawing, singing, and experiencing beauty and wonder and enjoyment of the outdoors. I am interested in setting up my classroom and programming in a proactive and thoughtful way that honours children's need to play and their need to learn how to 'be' within the context of a group."

Comments re: CHILDREN HELPING AND SUPPORTING ONE ANOTHER

Tools teachers

"The students in my class get along with each other. They may have a preference for a child they would like to play with. However, it is usually because the child is interested in the same activity. Boys and girls play together, boys play with boys and girls play with girls. It is a mixed but close community. I am told about a child being hurt on the playground by a number of children. In years past, they have not helped each other to this degree, when a child was hurt but now have witnessed many students going to another students' aid. I see our classroom has a warm and accepting place. One mother, the mother of the student with extreme anxiety, went to the principal near the winter holiday time to tell the principal how much her daughter loved her teacher. The mother then came to me saying how thankful she was, as every day in China, her daughter did not want to go to school and now wanted to go to school (even when sick). The mother was extremely happy that her child felt safe and loved in our community."

"They offer help and assistance when needed without being asked and without belittling the struggling student. They look out for one another and ensure everyone has someone to play with or talk to….This behaviour even spills out to the outside playground."

Everyone plays and learns with all students. All of my students celebrate the efforts and successes of each child – regardless of ability. They also offer help and assistance when need without being asked or without belittling the struggling student. They look out for one another and ensure everyone has someone to play with or talk to… This

behaviour even spills out to the outside playground – it is truly AMAZING!

"I think the majority of students in my class are able to get alone with one another very well. They love to help and support each other and they are very kind and considerate to each other's feelings. The Tools program has really helped them feel comfortable working with other students in the class because they know that they will be working with different students each week. I also think the way the Tools program incorporates roles and responsibilities helps the students to accept their role or job in their group and there is no arguing over who has to do what job."

Students work willingly to help their peers during our day. When a new student joined our class with severe behavioural issues they were very accepting and tried to help this student integrate into our classroom routines.

They are much better at helping each other and they take their role as a buddy checker seriously. They like to make sure their buddy completed their work.

"Socially I have noticed that the students this year are more comfortable working with other students in the classroom.

"My students this year are very inclusive and are able to work with anyone in the classroom. Strong bonds between individual children and between all children. Children who may not have previously played with each other do."

"Students are now able to support each other without teacher involvement which is different from previous years."

"Students not comparing themselves to each other academically. They are cheering each other's success, are more supportive of each other."

Control-group teachers

"They tend to get along pretty well at this point in the year; we have some strong leaders who are 'friends with everyone' who, when they are present, are a very positive influence (will remind about appropriate social skills and behavior, 'you need to apologize for that', 'we don't do that here', etc). We also have a few children who have a very difficult time acting kind most of the time. This makes it difficult to have a totally close knit community, as these children, while they have progressed, still need significant support to make choices that benefit everyone and not just themselves."

"At this time in the year many students need mediated support to be respectful of one another's differences, to include other's in their play to advocate for their needs and to respect their peer's needs."

"Most challenging this year has been the lack of an established and harmonious classroom community where kindness, consideration and care are the norm….The students are learning to read and write, but their ability to be well-adjusted and considerate human being lags behind."

Comments re: SENSE OF COMMUNITY IN THE CLASSROOM

Tools teachers

"My students this year have a strong sense of community – in fact we are a strong-knit FAMILY. Everyone works, plays, and helps EVERYONE – without any moaning and groaning. They are far more adaptable, flexible and accepting of everyone regardless of appearance or ability."

"More of a sense of community [this year]. I see children helping each other and looking after each other to a greater degree from in the classroom to out on the playground at recess [than in past years]."

"We have a very strong sense of community. Students are quick to check on each other, if one is crying or angry, and show concern for a peer who is hurt. This I see more often than not."

"They have a strong sense of community *sense of community.*

"Student peer relationships are fantastic – know, play, and work with EVERYONE. Real sense of community/family."

"We are a tight-knit FAMILY. Have enjoyed seeing the kids working together so that all are successful."

"Last 2 years have been very trying with the student's social/emotional learning. There was very little self-regulation. This year with Tools there has been tremendous growth. They are better able to self-regulate their behaviour and be more patient, kind and inclusive."

Control-group teachers

"Their ability to work cohesively as a community or as a team is inconsistent from day to day and there are many days [even now in May] where the children's energy is 'scattered' and they seem to march to the beat of their own drum."

"Building a strong sense of community has been a challenge this year. At this time in the year [May]…their ability to work cohesively as a community or as a team is inconsistent from day to day."

Comments on ABILITY TO WORK INDEPENDENTLY

Tools teachers

"I see a big difference in the students now in May compared to September. All the students know the routines and can get to work without much prompting. They know the schedule and can start on the activities without my support."

"Greatest reward is…seeing kids so very proud of what they can do independently."

"Peers help their study buddy remain on task and regulate their behavior in small groups, and they require minimal teacher assistance to solve the minor issues that sometimes arise."

"Greatest reward from using Tools this year is children having more control of their own learning."

"Students at this time of year [May] are much more independent than in past years. They are able to look at the chart, find which group they are in and go to that area without any teacher support. They support each other and use peer regulation."

"Students are now able to support each other without teacher involvement which is different from previous years."

"They are able to articulate what they are working on and know how to get there (practice, help from a study buddy, teacher assistance)."

"I'm so thrilled to have children who can work independently! Many to all of my students are now able to work independently. Parents love the independence of the students."

"One way I've changed the way I've managed my classroom is by empowering my students through planning and activities to manage themselves."

"Children can be independent learners even in kindergarten!!"

Control-group teachers

"This is a very young class (most turned 5 in Oct/Nov/Dec) and in the beginning it was very, very challenging. They are so much better now, BUT we have a strong routine, review expectations frequently....I do feel that many have increased in their self-regulation abilities, but I do still need to play an active role in prompting/ modeling/ affirming behavior. They did not come to school with a great deal of independence, and some still need support in managing belongings, time, and behaviour."

The classroom is quite diverse. There are approximately 5 children who are still unable to work independently.

"At the beginning of the year only a few children were able to work independently. Now only a few ask for help continually without first trying on their own."

"I am continuing to struggle with the children listening to all the instructions when given an activity and then follow the instructions independently. I often have 4-5 children who will ask me what they need to do."

"A major challenge this year has been the range in abilities and motivation in my class."

Comments on SELF-REGULATION / ATTENTION REGULATION

Tools teachers

"In the fall I was really struck by the primal sense of the children – random, impulsive, distractible, emotional, the limitations were tangible. There is no comparison to their behaviour now – the beauty being it is second nature….They still are spontaneous but it's more 'appropriate' and not as 'off the wall'. They get tired and lose focus but it is after thinking hard. In my experience free time tended to be a bit crazy and hard to manage. Here it is not."

"The return to school after Christmas and Spring Break was smooth. Usually each return is like a mini-September – poor self-regulation and adjustment to school. Not this year. It was like the children were returning from a weekend away. In fact, on Mondays, return-to-school has also been much smoother. Very little re-adjustment after a weekend away."

"In 20 years I have never been able to come back from school holidays so seamlessly, with minimal learning lags and still have such great retention of information and routine!"

"We had a child move from very, very little regulation to now being unable to distinguish from peers. This child was very dangerous to others in Sept/Oct."

"At the beginning of the year, my students' ability to self-regulate was very limited. Now they are extremely independent, in-control and able to monitor and regulate themselves.

"Seems like there is more on-task behaviour and when students are off-task they are able to return to tasks easier."

"Many to all of my students are able to work independently. If there changes in the schedule or a full moon, etc., they only need gentle reminders or a quick self-regulation freeze game to come back to what is expected."

"The majority of students are able to regulate themselves better socially and emotionally….They are able to sustain elaborate play scenarios with multiple characters for extended periods of time! They are able to wait for their next turn. The students' growth in self-regulation and their excitement for learning [was the greatest reward of this year]!"

"Children are more independent and regulated. Ones who are not as regulated are regulated by others."

"A TOC [teacher-on-call, i.e., substitute teacher] recently commented how calm my class is."

Comments by *Tools* Teachers on the consequences of this:

"[Because] students are better regulated for sure than in past years, time is freed up for me to work with small groups. I have the freedom to work with small groups and help children learn at their own level; it helps provide students help where they need it and move them further faster. It is definitely more individualized and fits with our new curriculum. Students easily work in small groups and can self-regulate while I work with students who need support."

"They are very self-regulated so I am able to work with a small group without being distracted. This is a wonderful gift."

"The ability of my students to regulate their behaviour and to help those who still require some assistance has allowed me to be able to work with small groups as well as individually with specific students who require additional

assistance. I have never been able to effectively do this ever with kindergarten students before."

"Children are able to concentrate and be involved in activities for extended periods of time. That has made it far easier for me to work with individual students or small groups."

"The class (because of the students' self-regulation abilities) runs smoothly and seamlessly."

"Students are more independent and easier to manage….Management is easier and less stressful."

"At this time in the year [May]…there are many days where the children's energy is 'scattered' and they seem to march to the beat of their own drum."

"In my 3 years of teaching Kindergarten, I have never been able to effectively run small guided reading groups while the other students were engaged & working independently at literacy centres; this year I have been able to!"

Control-group teachers

"What I have enjoyed most is the growth I've seen. They were a MESS at the beginning. I felt like crying every afternoon. So many of them had low basic skills and very little independence, and their was a lot of fighting, crying, and meltdowns. They have come SUCH a long way. When I have been sick or facilitating PALS, every single TOC has said they were a joy to teach, which says to me that they are regulating well when I'm not there. – What has been most challenging has been sustaining my energy through the day. I feel that I need to verbalize much more with this group in terms of modeling appropriate behavior and social interactions. I feel that I need to hydrate and fuel with nutrition similar to the way I do when I am preparing for a long run."

"With the money [the $1,000 we gave each participating teacher for school supplies] I was able to purchase materials to create a softer, more natural atmosphere that would promote calm and would be conducive to self-regulation. Everyone remarks on what a calm, natural, and soothing environment I have in my classroom and I couldn't have made it that way without the funding."

"I've loved watching the children develop both socially and academically. At the beginning of the year, they could barely even sit on the carpet. They are so much better now."

"The classroom is quite diverse. There are… 4 children who have great difficulty self-regulating and controlling their actions/ impulses and or behaviour."

Comments on Children's JOY IN LEARNING and ENJOYMENT OF SCHOOL

Tools teachers

"I have enjoyed seeing the students get so excited about coming to school and learning about the topics/themes we had. They loved all the activities we did so much that many students refused to miss school even if they were sick."

"My greatest reward this year: Seeing the excitement of the students ready to learn and loving coming to school!"

"What I have you liked/ enjoyed most about my class this year is: All the learning that happened through play and dramatization. The smiles and joy. Hearing, "this is the best day, ever!" over and over again. The content parents who are extremely happy with what their children are doing."

"What I liked most about teaching this year: Students' enthusiasm towards learning and their pride in their development."

"What I liked most about teaching this year: The students excitement towards learning."

"The students' growth in self-regulation and their excitement for learning [was the greatest reward of this year]!"

"The students are more excited about learning and more engaged."

"Parents love it! They notice the student's excitement to learn and come to school!"

"The kids have fully bought in. There's no struggle in getting their attention or interest."

"Students are very motivated by subject matter, level of challenge and fun."

Control-group teachers

"I've loved watching the children develop both socially and academically."

"I enjoy my young students excitement and enthusiasm. And they learn so much in such a short time!"

Comments on FEELINGS ABOUT TEACHING

Tools teachers

"The fun and energy came back into my classroom and my teaching."

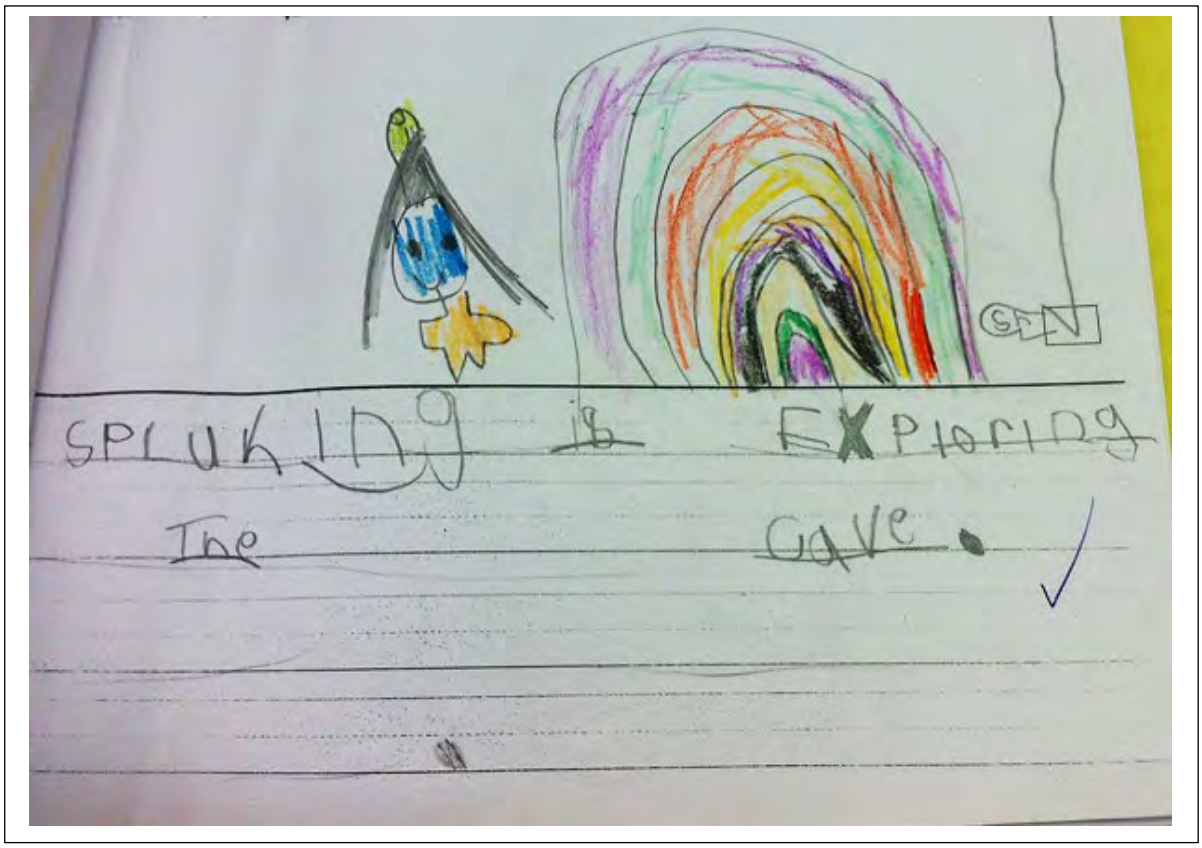
"I have seen so much success in my students' learning that I can't wait to begin teaching again next year now that I have a better understanding of the program and all of its benefits!"

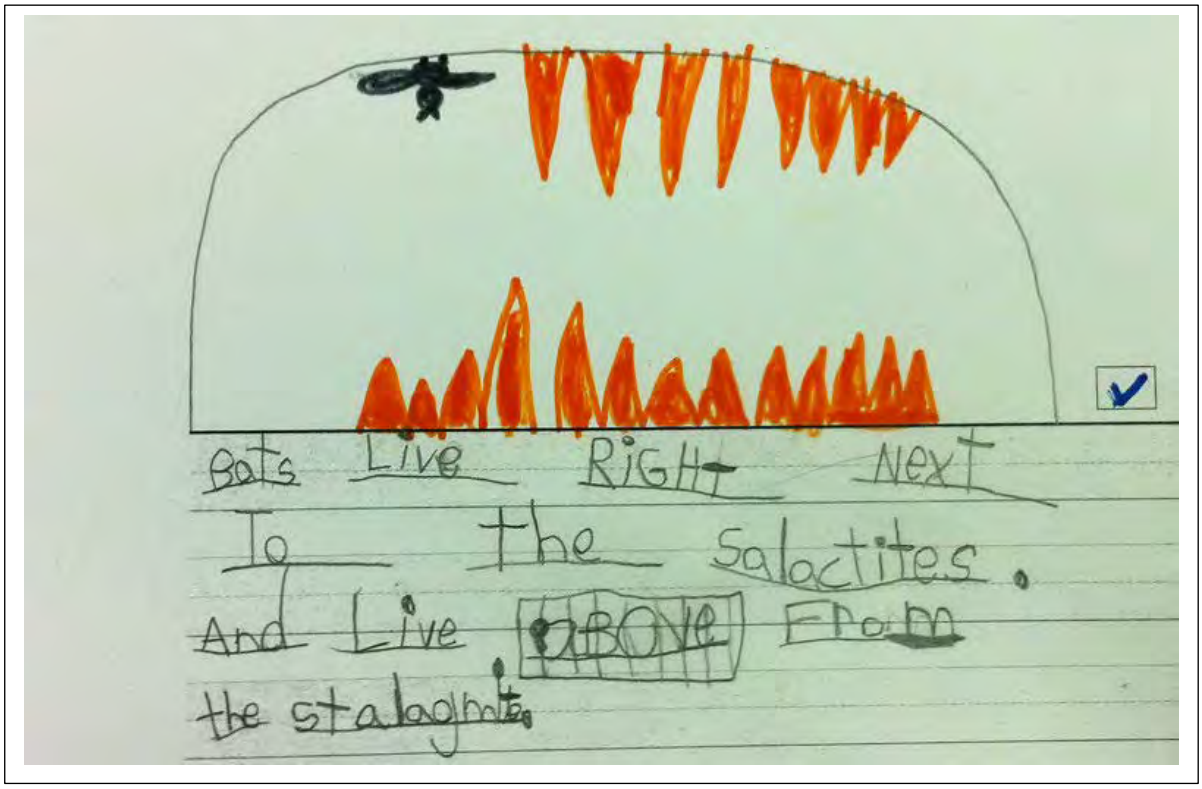
"Learning all the new materials was worth all the effort and it will get easier every year."

"I am excited to have this year under my belt and to really be able to run with it next year. Learning was more exciting for me and the kids!"

Control-group teachers

Two Writing Samples from Kindergarten Children in *Tools of the Mind*





These were written the week after the children had had a lesson on caves.