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Preparing Students to Kindergarten Using UPSTART at Home

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UPSTART is an in-home preschool program that uses CAI to provide children an individualized reading curriculum. UPSTART forms a partnership with parents to ensure their children use the program for fifteen minutes per day, five days per week. This report summarizes the results of seven years of data. Data was collected using WACS, Bader, and Brigance. At the conclusion of each program year, children who have met the usage requirements have been assessed at the Kindergarten Advanced level. This average is regardless of ethnicity, socio-economic status, and geographic locale. Additionally, students who participated in the UPSTART program significantly outperformed control students on multiple reading subskills.

INTRODUCTION

Language and word learning skills are significantly affected by early life experience (Hart & Risley, 1995), and early reading difficulties can sometimes appear even before a child enters kindergarten. By the age of three, the average vocabulary of a child growing up in poverty will include

significantly less words than that of a child growing up in an economically secure household (Hart & Riley 2003). Whether a problem begins before or during the time a child starts school, research has noted that large differences in reading technique and achievement are made apparent early in a child's educational career, and that these differences are frequently indicative of greater difficulties to come (Hoff, 2013). Students that are behind during the first years of school tend to learn at a slower rate than students who begin ahead. Often, this results in a so-called "Matthew effect" for reading skills, in which the academically "rich" become richer and the "poor" become poorer (Duff, Tomblin, & Catts, 2015; Stanovich, 1986).

Many recent efforts to improve reading instruction in U.S. primary schools have not been met with encouraging results, especially among lower-performing students (Darling-Hammond, 2007; Darling-Hammond, et al., 2016; Murmane, Sawhill, & Snow, 2012). In 2013, the National Assessment of Educational Progress (NAEP) reported that 32% of American fourth grade students performed at the lowest level (Below Basic) on the NAEP reading skills test, a measure of reading comprehension (National Center for Education Statistics [NCES], 2015). Recent efforts to improve reading instruction on a national scale, like the No Child Left Behind Act, its accompanying Early Reading First program, and the Every Student Succeeds Act, have moved public schools toward setting more specific goals for accountability and instructional methods for reading (Darling-Hammond, et al., 2016).

Results from recent federal efforts, while encouraging in certain areas, have not proven to be unequivocally positive; scores from the 2015 NAEP show that progress in early reading achievement continues to be very slow, even though progress has been made by lower-performing students in the early grades. The 2015 test showed no significant changes in racial/ethnic gaps, gender gaps, or gaps by type of school when compared to scores from 2013, and reading average scores among fourth-graders improved on the 2013 test scores by a single, statistically insignificant percentage point (NCES, 2015). Making improvements to early reading instruction continues to present a substantial problem for both educators and policymakers.

A Unique Home-Based Solution

Heckman (2001) demonstrated the importance of concentrating financial investments with preschool children, where the return on investment appears to be the greatest. As a consequence of Heckman's research, about

80% of states have introduced some version of a universal preschool approach. However, the cost of traditional classroom-based pre-kindergarten programs is estimated to be $8,700 per child (National Institute for Early Education Research [NIEER], 2010), including facilities, administration, and support services. This cost is high enough to be prohibitive for states, especially during economic downturns when states' resources are strapped meeting existing K-12 program needs.

In addition to the cost element, research also brings into question some aspects of universal pre-kindergarten. Loeb, Bridges, Bassock, Fuller, and Rumberger (2005) noted in a Policy Analysis for California Education report that about two-thirds of children in America currently attend a preschool, and while attendance generates modest intellectual gains, the data on the behavioral impact of preschool on the children is mixed at best. Their data is drawn from a study of over 14,000 students, and this work heightens the importance of finding alternative solutions to institutionalized preschool. Perhaps even more importantly, their work defines the academic limits of what can be expected from a universal preschool program.

Learning at home is an available and viable preschool alternative. The home has immense potential for influencing a child because, from birth until high school graduation, only a small portion of a student's life is occupied by actively being a student. The percentage that a child is awake that is spent studying has been estimated at 13% (Walberg, 2003). Adding more hours to the school day, or more days to the year, is a perineal subject brought forward for educational reform as a means to foster learning (Patall, Cooper, & Allen, 2010). Until the calendar is reformed, time available at home is a major untapped resource for addressing the time limitations of traditional educational settings.

Effectiveness of Waterford Early Learning

Research examining the effectiveness of adaptive, sequence-based computer-assisted instruction (CAI) has been very positive. The use of adaptive learning systems in early education classrooms has resulted in greater reading ability gains compared to controls for kindergarteners living in poverty (Comaskey, Savage, & Abrami, 2009), ELL kindergarteners (Lopez, 2010; Powers & Price-Johnson, 2006), suburban kindergarteners (Macaruso & Walker, 2008), and suburban first graders (Macaruso, Hook, & McCabe, 2006; Savage, Abrami, Hipps, & Deault, 2009; Saine, Lerkkanen, Ahonen, Tolvanen, & Lyytinen, 2010). *Waterford Early Learning* ™ (WEL), which

serves as UPSTART's home curriculum, has been formally assessed in a variety of schools and districts of varying size, location, and socioeconomic status, and results are consistent in supporting the software's considerable effectiveness. After a statewide implementation of the software (n = 2,414) in Idaho kindergartens, evaluators, working in connection with the Albertson Foundation, reported strong evidence from a representative sample of eight school districts for its effectiveness among academically disadvantaged students. After one year with the program, the effect size for students who had originally tested in the lowest third on standardized reading measures was 1.14, and the overall effect size for students who completed the program was a Cohen's d of 0.52.

Cassady and Smith published the first of two Waterford-related studies in 2003. An Indiana school implemented the software in its kindergarten classes to work in conjunction with existing literacy instruction. The evaluation used the Phonological Abilities Tests (PAT) at three points during the trial year (beginning, middle, and end) to assess student gains for basic literacy skills. Another school in the area, which had not implemented the program at all, served as the control group. Teachers in both schools, as participants in the Intentional Reading Project (IRP), were engaged in ongoing professional development activities, and both schools received various other resources throughout the year; however, the researchers were careful to ensure that Waterford software was the principal curricular difference. Despite no significant differences in pretest scores, students using the software experienced a faster acquisition of phonological awareness skills than students who had not used the program, F (2, 85) = 3.05, $p < .05$, 2 = .07.

As a follow-up to their study with kindergarteners, Cassady and Smith (2015) examined the effect on reading achievement gains during the first grade year. Again, students who used the software experienced significantly greater reading skill gains on a standardized test (the CTBS Terra Nova) than the comparison group, F (1, 91) = 10.61, $p < .01$, 2 = .10. Researchers also noted that it was the lowest-performing students who benefited most from the program: These students dramatically outperformed the low-performing comparison group, F (1, 21) = 15.67, $p < .01$, 2 = .43. By the end of the first grade year, test scores among this at-risk group were equivalent to those of the moderate-performing students in the comparison classes.

The What Works Clearinghouse reviewed an Ohio study that included more than 70 kindergarten students from six schools in Ohio and found evidence (with reservations) supporting the reading software's value for alphabetics and comprehension. In evaluating its effectiveness, WEL was found to have potentially positive effects on alphabetics—+19 percentile points—

while the comprehension improvement index was +4 percentile points (What Works Clearinghouse, 2007).

Technology-Delivered Curriculum and a Proactive Support Organization

Home-based learning, of course, raises the issue of curriculum and academic supervision. Technology can provide an innovative and cost-effective curriculum, and software can individualize instruction to a degree necessary to undergird the successful education of children (Christensen, Johnson, & Horn, 2008). CAI in the classroom has been shown to allow for a dynamic presentation of material, individualized instruction, and a high level of engagement in the learning process. CAI can provide immediate feedback to responses, reinforcement, and, in some cases, an adaptive, learner-centered course of instruction. These benefits have been related to substantive student gains in knowledge (Tamim, Bernard, Borokhovski, Abrami, & Shmidt, 2011; Van der Kleij, Feskens, & Eggen, 2015) and may help eliminate certain impediments to effective intervention among younger school-aged students and at-risk children (e.g., Fish et al., 2008). Additionally, the use of software is artistically engaging for children and is generationally appropriate—today's children are "digital natives" and adapt quickly and easily to software-based instruction. Waterford's UPSTART program places technology in the home and uses it to offer a strong, individualized academic program for preschool children. If a child spends just fifteen minutes per day, five days per week—the minimum requirement for participation in UPSTART—using the software, s/he will be provided with 90 hours of individualized instruction in a year, which is 30 times the amount of individualized instruction that a school environment can offer (Conant, 1973).

Equally as important as the software curriculum is academic supervision. UPSTART draws upon the home's resources—available time, the presence of a concerned parent or caregiver, a reliable environment to learn, known daily routines—to help address critical education needs. To assist the home component, Waterford has established the UPSTART User Support Center to provide technical, motivational, and curriculum support. Within the center, representatives answer questions, respond to concerns, and also proactively motivate program participants to achieve optimal use and results from the program. Representatives are assigned a yearly caseload of approximately one hundred homes and establish communication and support lines with their participants.

METHOD

Participants

For each year, participants consisted of a treatment group of children who were enrolled in the UPSTART program during the year prior to kindergarten, and a control group of children of the same age who were not enrolled in the UPSTART program.

Year 1 participants consisted of 384 children, including 137 in the treatment group and 247 in the control group, and were assessed with Dynamic Indicators of Basic Early Literacy Skills (DIBELS) Next.

Year 2 participants consisted of 190 children, including 95 in the treatment group and 95 in the control group, and were assessed with the Brigance Inventory of Educational Development (Brigance) measures and Bader Reading and Language Inventory (Bader) measures.

Year 3 participants consisted of 305 children, including 151 in the treatment group and 154 in the control group, and were assessed with the Brigance and Bader measures.

Year 4 participants consisted of 220 children, including 117 in the treatment group and 103 in the control group, and were assessed with the Brigance and Bader measures.

Year 5 participants consisted of 271 children, including 109 in the treatment group and 162 in the control group, and were assessed with the Brigance and Bader measures.

Year 6 participants consisted of 529 children, including 200 in the treatment group and 329 in the control group, and were assessed with the Brigance and Bader measures.

Materials

Waterford's approach to implementing the UPSTART program centers on three software components: *Waterford Early Learning Program (WEL)* is the main curriculum and focuses on reading readiness; *Camp Consonant*™ assists multi-sensory learners; and *Waterford Assessments of Core Skills*™ (WACS) assesses early literacy. In addition, three measures have also been used to assess student performance: Dynamic Indicators of Basic Early Literacy Skills (DIBELS), Brigance Inventory of Educational Development, and Bader Reading and Language Inventory.

The Waterford Early Learning Program (WEL)

WEL provides individualized curriculum depth and richness with more than 450 instructional hours. UPSTART students are required to use WEL for at least fifteen minutes per day, five days per week, a pattern designed to strengthen neural pathways by providing consistent repetition of the learning activities. Usage is tracked within the program and monitored weekly by Waterford personnel.

Camp Consonant

Camp Consonant, with more than 150 hours of instruction, provides children who need to overcome reading problems the consistent, intense, structured study they need. In UPSTART, the child simply replaces WEL with Camp Consonant, using the program fifteen minutes per day, five days per week.

Waterford Assessment of Core Skills

Waterford Assessments of Core Skills™ (WACS) is an adaptive reading assessment designed to assess eleven key pre-literacy and reading skills. WACS is administered at the beginning and end of the UPSTART pre-kindergarten year to measure learning gains, and consists of 11 separate subtests. Initial content validity for WACS was established against state and national standards. All items were then calibrated for Item Response Theory to determine item difficulty. To establish concurrent validity and predictive validity student performance on WACS was compared to performance on five commonly used standardized tests also measuring early reading skills; all correlations between tests are significant, ranging from $r = .41$ to $r = .78$ (median $r = .63$). Additional analyses indicate that WACS is internally consistent and has strong test-retest reliability ($r = .90$).

Dynamic Indicators of Basic Early Literacy Skills (DIBELS)

The DIBELS is comprised of six measures that function as indicators of the essential skills that every child must master to become a proficient reader. The DIBELS® measures are brief, and are used to regularly monitor the development of early literacy and early reading skills. DIBELS was designed for use in identifying children experiencing difficulty in the acqui-

sition of basic early literacy skills, in order to provide support early and prevent the occurrence of later reading difficulties.

The Brigance Inventory of Educational Development

The Brigance assessment measures phonics and vocabulary knowledge. Ten subtests were selected from the language development and academic/cognitive sections of the Brigance. A composite Brigance score was created by adding the scores from the ten subtests, to create a comprehensive score of literacy achievement.

The Bader Reading and Language Inventory

The Bader assessment measures phonological awareness, including the ability to detect structure of spoken words in terms of rhyming, syllables, and phonemes. The assessment includes three subtests, as well as a composite Bader score created by adding the scores from the subtests.

Procedures

The software programs offer a home-access solution to three key objectives necessary for children to achieve reading success: access to vocabulary and spoken words from birth through age four; access to training in the alphabet, print concepts, and phonemic awareness—skills identified as essential for reading success; access to additional instruction for the 20% of children who struggle with reading and, as a result, need tutoring; and access to assessment so training and intervention can begin even before formal schooling begins.

The two WACS testing sessions coincide with parent/caregiver meetings. At the first meeting, parents are given an overview of the research-based program and its successful results. In order to participate they are asked to commit to the usage requirement of fifteen minutes per day, five days per week. If they are reluctant to maintain the necessary usage, they simply exit the meeting without equipment once their child completes WACS. Equipment is distributed to those who do commit, along with easy to understand instructions on installing the software or setting up the preloaded computers. Parents are guided through the WEL Parent Manager, and the resource role of Waterford support personnel and the district liaison

is explained. Parents are also advised of the weekly usage emails and introduced to the UPSTART websites—both in English and Spanish—as an ongoing program resource. Supporting activities are discussed, and Camp Consonant is described as a potential alternative for some children. As with all UPSTART activities, sessions are conducted in both English and Spanish. At the conclusion of the program, parents and caregivers fill out an in-depth evaluation of the program (provided in both English and Spanish). Families are encouraged to attend and celebrate, as UPSTART children and parents/caregivers receive diplomas and congratulatory certificates.

Ongoing assistance is provided by Waterford's UPSTART User Support Center, which provides both technical and curriculum support. Within the center, sixty percent of center representatives speak both English and Spanish, and representatives function similarly to education paraprofessionals, providing assistance to parents/caregivers using a variety of strategies that have been proven to work. They prepare instructional materials for the program website, monitor participant usage, and support parents/caregivers and their children by not only answering questions and responding to concerns, but also by motivating program participants to achieve optimal use and results from the program. Programmatic and technological support cases and all other interactions with families are logged on the UPSTART database. Frequent communication is supported by written materials, DVD and online training, emails, and phone calls. Representatives also provide basic technical support, and, if necessary, they move more difficult technical issues to UPSTART field support representatives. Overall, the strategy is to provide families with a steady stream of data on children's usage and performance as well as to introduce motivational strategies for maintaining parent and child interest. This unique support system forms a partnership with parents and caregivers to ensure their children obtain the education necessary to start them on the path to success in school.

RESULTS

WACS Gains and Usage

Using WACS as the measure, on average, UPSTART participants completed the program at the Kindergarten Advanced level (Table 1). (In WACS scoring, if a student receives a Kindergarten Advanced score, it indicates that the student's ability is similar to the ability level of the top third of kindergarteners nationwide). This average is for students from rural and urban

settings, all ethnicities, and upper and lower SES levels. Final WACS score data by ethnicity, SES, language, and other preschool attendance are found in Tables 2-5.

Table 1

WACS Pre- and Posttest Results by Skill

Skill	**Pretest Score**	**Posttest Score**
Letter Recognition	Pre-K Advanced	K Beginning
Letter sound	K Beginning	K Advanced
Blending	K Intermediate	1st Beginning
Initial Sound	K Intermediate	K Intermediate
Listening Comprehension	K Beginning	1st Beginning
Real words	K Advanced	1st Beginning
Nonsense Words	K Advanced	1st Beginning
Sight Words	K Intermediate	K Advanced
Reading Comprehension	K Intermediate	K Advanced
Vocabulary	K Intermediate	1st Beginning

Table 2

WACS Posttest Results by Ethnicity

Ethnicity	**Final WACS Score**	**Grade Equivalent**
African American	2918	K Advanced
American Indian/ Alaska Native	2907	K Advanced
Asian/Pacific Islander	2935	K Advanced
Caucasian	2929	K Advanced
Hispanic	2733	K Advanced

Table 3

WACS Posttest Results by Language

Language	**Final WACS Score**	**Grade Equivalent**
English	2928	K Advanced
Spanish	2656*	K Intermediate

Table 4
WACS Posttest Results by SES

SES	Final WACS Score	Grade Equivalent
Lower SES	2852	K Advanced
Higher SES	2980	K Advanced

Table 5
WACS Posttest Results by Preschool Attendance

Preschool	Final WACS Score	Grade Equivalent
Attended Preschool	2986	K Advanced
Did Not Attend Preschool	2902	K Advanced

Pre- to post-growth was measured and demonstrated using WACS results in year 1 through 6. Participants completed the program at Kindergarten Advanced level according to WACS (Figure 1).

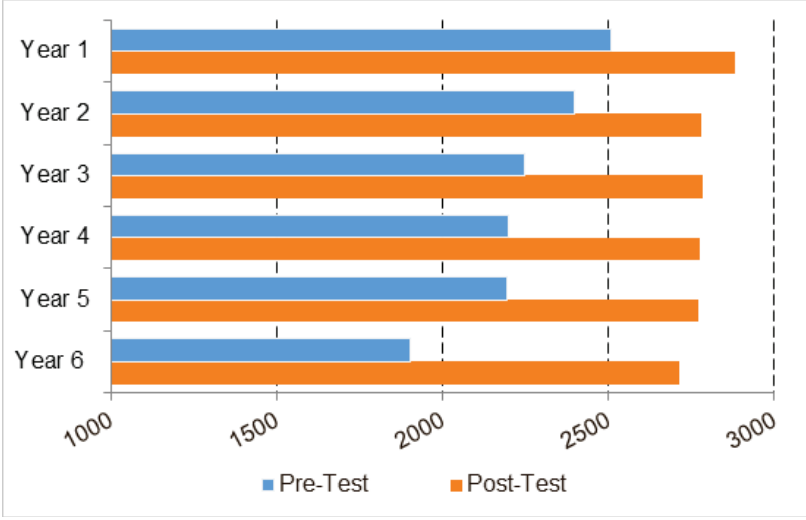

Figure 1. WACS pretest and posttest scores by year.

Year 1

DIBELS

In Year 1, it was found that children who had participated in UPSTART during preschool scored almost 18 points higher in reading proficiency as measured by the DIBELS beginning of kindergarten Composite scores compared to kindergarten children who did not participate in UPSTART. Additionally, kindergarten children who had participated in the UPSTART preschool program scored approximately 19 points higher in reading proficiency as measured by the DIBELS middle of kindergarten Composite scores compared to children who did not participate in UPSTART.

Year 2

Although the control group scored significantly higher on the auditory discrimination Brigance pretest, the treatment group and the control group performed about equally on the overall Brigance at the pretest.

As shown by posttest results, the UPSTART treatment group performed significantly better than the control group on the Total Brigance, with an average difference of 7.9 points (Evaluation and Training Institute, 2012). Additionally, the treatment group performed significantly better on Lowercase Letter Knowledge and Sounds of Lowercase Letters.

The effect size for the treatment group on the Brigance is in the medium effect size range (partial R Square .16).

Bader Pretest and Posttest Results

The treatment group and the control group performed about equally on the Total Bader and on each of the Bader subtests at the pretest.

As shown by posttest results, the UPSTART treatment group performed significantly better than the control group on the Total Bader, as well as on the Phoneme Blending subtest.

The effect size for the treatment group on the Bader is in the small effects size range (partial R square=.08).

Brigance Growth Score Results

Favoring the UPSTART treatment group, growth rates between the treatment group and the control group were significantly different at the 99% Confidence Interval (CI) for the Total Brigance and for the Sounds of Lower Case Letters subtest.

Bader Growth Score Results

Favoring the UPSTART treatment group, growth rates between the treatment and control group were significantly different at the 99% CI for the Total Bader and for the Phoneme Blending subtest (Evaluation and Training Institute, 2012).

Year 3

Brigance Pretest and Posttest Results

The treatment group and the control group performed about equally on the overall Brigance at the pretest.

As shown by posttest results, the UPSTART treatment group performed significantly better than the control group on the Total Brigance, with an average difference of 27.98 points, as well as on all but one of the Brigance subtests (Evaluation and Training Institute, 2013).

Favoring the UPSTART treatment group, effect sizes were calculated to show UPSTART's impact at the Total Brigance posttest and on all Brigance subtests. Effect sizes range from .33 to .84, including small, medium and large effects.

Bader Pretest and Posttest Results

Although the control group performed better than the UPSTART treatment group on two of the Bader subtests, the treatment group and the control group performed about equally on the Total Bader and the other Bader subtests at the pretest.

As shown by posttest results, the treatment group performed significantly better than the control group on the Total Bader, with an average difference of 5.95 points, as well as on each of the Bader subtests.

Favoring the UPSTART treatment group, effect sizes were calculated to show UPSTART's impact at the Total Bader posttest and on all Bader subtests. Effect sizes range from .43 to .85, including small, medium and large effects.

Brigance Growth Score Results

Favoring the UPSTART treatment group, growth rates between the treatment group and the control group were significantly different at the 99% Confidence Interval (CI) for the Total Brigance and for five of the Brigance subtests: Vocabulary, Sight Words, Auditory Discrimination, Letter Sounds, and Recites Alphabet.

Bader Growth Score Results

Favoring the UPSTART treatment group, growth rates between the treatment and control group were significantly different at the 99% CI for the Total Bader and for each of the Bader subtests (Evaluation and Training Institute, 2013).

Year 4

Brigance Pretest and Posttest Results

The control group performed significantly higher than the UPSTART treatment group on the overall Brigance at the pretest. These differences can potentially be related to the significant difference between the number of control group children attending preschool at the time of the pretest (81%) compared to the number of UPSTART treatment group children attending preschool at the time of the pretest (31%).

As shown by posttest results, the UPSTART treatment group performed significantly better than the control group on the Total Brigance, with an average difference of 16.44 points, as well as on Visual Discrimination, Letter Sounds, and Vocabulary subtests (Evaluation and Training Institute, 2014).

Favoring the UPSTART treatment group, effect sizes were calculated to show UPSTART's impact at the Total Brigance posttest and on all Brigance subtests. Effect sizes range from .39 to .59, including small and medium effects.

Bader Pretest and Posttest Results

The control group performed significantly higher than the UPSTART treatment group on the overall Bader at the pretest, again potentially related to the number of control group children attending preschool at the time of the pretest.

As shown by posttest results, the UPSTART treatment group performed significantly better than the control group on the Total Bader, with an average difference of 3.89 points, as well as on two of the three Bader subtests: Phoneme Blending and Phoneme Segmenting.

Favoring the UPSTART treatment group, effect sizes were calculated to show UPSTART's impact at the Total Bader posttest and on all Bader subtests. Effect sizes range from .48 to .56, including medium effects.

Brigance Growth Score Results

Favoring the UPSTART treatment group, growth rates between the treatment group and the control group were significantly different at the 99% Confidence Interval (CI) for the Total Brigance and for four of the Brigance subtests: Vocabulary, Sight Words, Letter Sounds, and Recites Alphabet.

Bader Growth Score Results

Favoring the UPSTART treatment group, growth rates between the treatment and control group were significantly different at the 99% CI for the Total Bader and for two of the Bader subtests: Phoneme Blending and Phoneme Segmenting (Evaluation and Training Institute, 2014).

Year 5

Brigance Pretest and Posttest Results

The UPSTART treatment group and the control group performed about equally on the overall Brigance at the pretest.

As shown by posttest results, the UPSTART treatment group performed significantly better than the control group on six of the 10 Brigance subtests*:* Visual Discrimination, Recites the Alphabet, Lowercase Letter Knowledge, Letter Sounds, Auditory Discrimination, and Vocabulary. Al-

though the treatment group scored 8.7 points higher than the control group on the Total Brigance posttest, the difference was not statistically significant (Evaluation and Training Institute, 2015).

Favoring the UPSTART treatment group, effect sizes were calculated to show UPSTART's impact at the Total Brigance posttest and on 6 of the Brigance subtests. Effect sizes range from .30 to .85, including small, medium and large effects.

Bader Pretest and Posttest Results

The UPSTART treatment group and the control group performed about equally on the overall Bader at the pretest.

As shown by posttest results, the UPSTART treatment group performed significantly better than the control group on the Total Bader, with an average difference of 5.33 points, as well as on all Bader subtests.

Favoring the UPSTART treatment group, effect sizes were calculated to show UPSTART's impact at the Total Bader posttest and on all Bader subtests. Effect sizes range from .27 to .73, including small and large effects.

Brigance Growth Score Results

Favoring the UPSTART treatment group, growth rates between the UPSTART treatment group and the control group were significantly different at the 99% Confidence Interval (CI) for three of the Brigance subtests: Letter Sounds, Auditory Discrimination, and Vocabulary.

Bader Growth Score Results

Favoring the UPSTART treatment group, growth rates between the UPSTART treatment and control group were significantly different at the 99% CI for the Total Bader and for two of the Bader subtests: Phoneme Blending and Phoneme Segmenting. (Evaluation and Training Institute, 2015).

Year 6

Brigance and Bader Pretest and Posttest Results

The matched UPSTART treatment group and the control group performed about equally on the overall Brigance at the pretest. The matched

UPSTART treatment group and the control group performed about equally on the overall Bader at the pretest. Combined posttest results showed that UPSTART participation had a large impact on students' early literacy skill development. Additionally, the UPSTART treatment group performed significantly better than the control group on eleven of the thirteen Brigance and Bader subtests.

In the matched posttest sample, large effect sizes (.95 and .81) were shown favoring UPSTART students as measured by the total Bader and Brigance composite scores.

Brigance and Bader Growth Rate Results

Favoring the UPSTART treatment group, differences in growth rates between the UPSTART treatment and control group were significantly different for the overall Brigance and for eight of the ten Brigance subtests.

Favoring the UPSTART treatment group, differences in growth rates between the UPSTART treatment and control group were significantly different for the Total Bader and for all three Bader subtests.

Figures 2 and 3 show mean growth for experimental and control groups for years 2 through 6 for Bader and Brigance respectively.

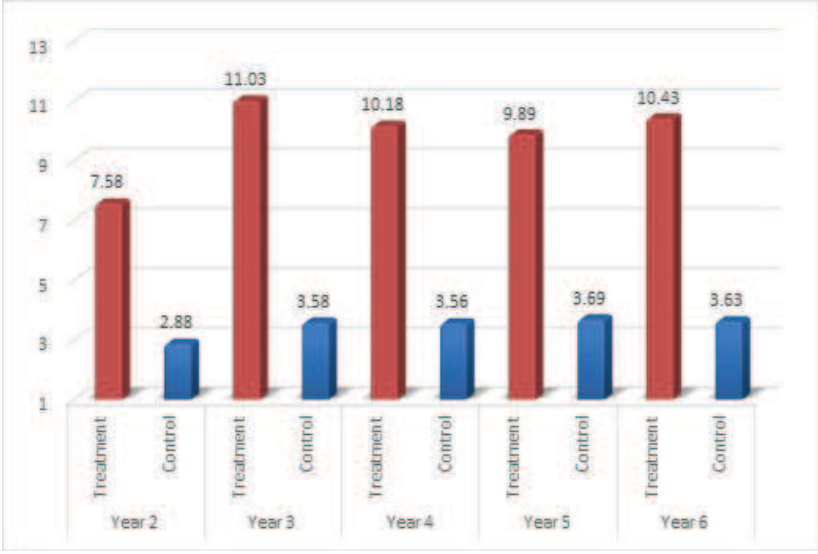

Figure 2. Bader Mean Growth.

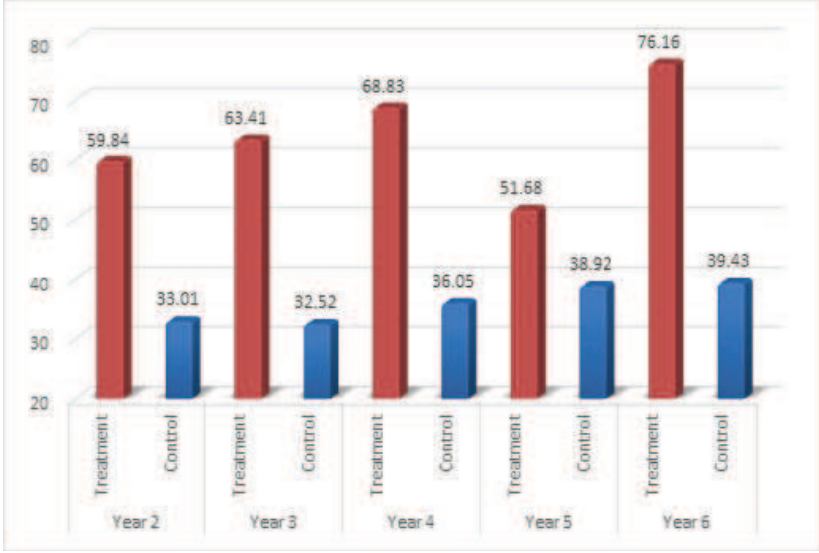

Figure 3, Brigance Mean Growth.

DISCUSSION

UPSTART is an in-home preschool program that uses Waterford's software to provide preschool-age children with an individualized reading, math, and science curriculum with a focus on reading instruction. Six years of research have documented its effectiveness in advancing and maintaining children's academic skills and preparing them for school. Children who used UPSTART had an 18-point advantage on DIBELS in early kindergarten when compared to students in the control. When assessing students in middle kindergarten that advantage rose to 19 points. Over years of UPSTART implementation where the Brigance Inventory of Early Development and the Bader Reading and Language Assessment were the principle metrics, students using the program consistently benefited from higher mean growth rates compared against students in the control. In the second year of UPSTART implementation, participating students using the CAI curriculum saw increased gains in overall performance on the Bader compared to control, with noted improvements in *Phenome Blending*. In the same year, participants using UPSTART benefited from a 7.9 point overall advantage on the Brigance when compared to participants in the control, with notable advantages *in Lowercase-Letter Knowledge* and *Sounds of*

Lowercase Letters subtests. Participation in UPSTART was also shown to have a positive impact on subtest performance, where, by the sixth year of implementation, UPSTART students had significantly higher scores when compared against the control students for all Bader subtests and eight out of ten of the Brigance subtests. All students who met the recommended usage criterion rating were assessed at a Kindergarten Advanced level. Use of UPSTART laid a groundwork for academic success.

Whenever a new technology is introduced there is always the possibility that it will be put to use by those individuals who, for whatever reason, are best able to afford it rather than for those who stand to gain the most. The implementation of CAI in education is an instance in which technology can bend towards maximum social utility. In the current study, all students using UPSTART met or exceeded the recommended usage criterion. The usage of students in traditionally disadvantaged groups exceeded that of their peers. Students in low socioeconomic status families and students in demographic minorities spent more time with the curriculum. These results point to UPSTART, and CAI in general, as a means of ameliorating a number of achievement gaps. These results are consistent with, and extend the findings of, prior research which point to CAI as a means of assisting academically disadvantaged students (Comaskey, Savage, & Abrami, 2009; Lopez, 2010).

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