How Early Experiences in Cognitive Development Improve Working Memory and Processing Speed Skills of Children

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Abstract

Providing the support that children need to build cognitive skills (i.e. working memory and processing speed) has come to the forefront for special educators today. This study investigated how fourth-grade students within an experimental classroom (N=14) and special education students within a small group setting (N=9) improved their working memory and processing speed through a self-designed board game. Board game activities were conducted for three months. Data were collected from 14 heterogeneously grouped students in an experimental classroom (N=22) and student within a small group setting in the special education classroom setting (N=9). The effects of working memory and processing speed interventions were administered through individual pre- and post- standardized measures. Descriptive statistics for post-test student assessments show no statistical significance in working memory and processing speed. The results of this study suggest that a short-term intervention to increase working memory and processing speed is not impactful. Longer interventions may prove to be more successful and should be examined.

Keywords: working memory, processing speed, special education

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Today's classrooms are identified as "diverse" (Volts, Sims, & Nelson, 2010, p.1). According to Volts, Simms, & Nelson (2010), "Nearly half of all students in U.S. public schools (42 percent) are students of color, approximately 20 percent of students speak a language other than English at home, and approximately 14 percent of students have an identified disability. Approximately half of the students who have an identified disability spend 80 percent of their school day in general education classrooms" (p.1). With such diversity and differences, students are expected to reach the same academic goals and standards within our classrooms today (Volts, Sims, & Nelson, 2010, p.1).

Now picture sitting in these diverse classrooms and having nothing make sense (Garner, 2007, p.1). Despite teachers utilizing research-based instructional practices and working hard to meet these diverse challenges, some students may not "get it" while others do (Garner, 2007, p.1). We try to reach the students who "do not get it" through after-school programs, remedial reading and mathematics programs, summer school, tutoring, and through small group/individual instruction in the special education setting (Garner, 2007, p.1). Many still struggle, leaving teachers and parents baffled.

Defining “student success” is one of the biggest challenges in education today. Most focus on quantifiable data such as grade point averages and standardized tests, but those only provide part of the picture, especially at the elementary level. According to Elementary Education- Current Trends (2018), “The rapid changes in cognitive, social, and moral growth of an elementary school student makes the elementary classroom an ideal setting for shaping individual attitudes and behaviors (p.2).” Numerous reforms (i.e. No Child Left Behind) have had lasting changes in elementary schooling, while others have gone away just as quickly as they came in. No matter the circumstance, elementary education is an exciting time for reform and changes, however, we continue to grapple with the necessary skills and knowledge needed for the twenty-first century. The term “intelligence” has challenged educators and researchers for many years (Lynch & Laverne, 2012, p. 347). Many influential theorists, such as Piaget, Montessori, and Froebel, have provided theoretical underpinnings that suggest children learning best as a “result of environmental factors, “sensitive periods”, and developmental stages (Lynch & Laverne, 2012, p. 347). Recent research now highlights that there are many facets of intelligence, to include a “combination of genetic factors, environmental influences, and life experiences that affect learning in unique ways” (Lynch & Laverne, 2012, p. 347).

A Functional Theory of Working Memory

For the purposes of this study, working memory refers to “a complex cognitive system that is responsible for the storage and processing of information in the short term” (Sarette, 2014, p. 23). It is the ability to temporarily store and manipulate information simultaneously and is considered an important predictor for academic performance in such areas as reading and mathematics (Van de Weijer-Bergsma, Kroesbergen, Jolani, & Van Luit, 2015, p. 756). Although there are several models of working memory, the most widely known and the one that has proved most robust in the face of research evidence is that of Baddeley and Hitch (Sarette, 2014, p. 25).

This study focuses on Verbal Working Memory (i.e. the Phonological Loop) from the Baddeley and Hitch model. It is “responsible for the temporary storage of verbal information: items are held within a phonological store of limited duration, and the items are maintained within the store via the process of articulation (inner vocalization)” (Swanson, Jerman & Zheng, 2008, p. 343). According to Montgomery, Magimairaj, & O’Malley (2008), findings from their research suggest that children between the ages of six and twelve years of age use working memory potential to process and comprehend familiar complex sentence structures (p. 349). Kanerva & Kalakoski (2016) found that sixty-eight adolescents working memory span tasks play a role in predicting academic achievement, particularly with less demanding tasks (p. 688). Karpiacke, Blunt, & Smith (2016) research led to results that practicing retrieval of information can be an effective learning strategy for children with varying levels of reading comprehension and processing speed (p. 7). According to Schneider and Ornstein (2015), “brain growth increases in knowledge, strategy use, processing speed, and changes in the rate of memory trace decay, which in turn helps to contribute to developmental changes in working memory (p. 193).

A Functional Theory of Processing Speed

For the purposes of this study, processing speed is defined as “the time required to complete a cognitive, language, or motor process accurately” (Poll, Miller, Mainela-Arnold, Adams, Misra, & Park, 2013, p. 330). It is widely known that children with learning disabilities display difficulties with processing information, to include visual-spatial processing. Braaten & Willoughby (2014) state that there are three types of Processing Speed: Visual Processing, Verbal Processing (i.e. Listening), and Motor Speed (p. 12-13). One or more areas can often lead to a deficit in areas of functioning, to include academic processing (Braaten & Willoughby, 2014, p.13-14). This research practiced and assessed visual and motor processing speed types.

The rate at which students process information has been well researched. Cepeda, Blackwell, & Munakata (2013) found that processing speed "taps in to" executive control and can impact developmental change and individual differences (p. 269). Kail and Miller (2006) studied whether processing speed in the language domain developed at the same rate as global processing speed. Results suggested that children of the age of nine and fourteen showed nine-year old's to be faster on language tasks than on nonlanguage tasks and that a child's processing speed was moderately stable over a five-year span (p. 130-135). They also suggest that speed of processing increases rapidly in childhood, more slowly in early adolescence, and reaches mature levels in mid-adolescence (p. 130-135).

Weiler, Bernstein, Bellinger, and Waber (2002) studied children with ADHD-Inattentive Type who have "sluggish cognitive tempo's (p. 448). Results suggest that children with ADHD differed from those without ADHD on visual tasks but not auditory tasks (p. 448). Slow processing rates were not a function of inattention (Weiler, Bernstein, Bellinger, & Waber, 2002, p. 448). Results found by Mayes and Calhoun (2007) support Weiler, Bernstein, Bellinger, & Waber's research in that "children with ADHD and high-functioning autism have learning, attention, graphomotor, and processing speed weaknesses" (p.482). Research conducted by Wassenburg, Hendriksen, Hurks, Feron, Keulers, Vles, & Jolles (2008) found that with regard to processing speed, improvements were noted in grade six with gradual decreases over the grades (p. 204). In summary, results did not find a plateau in performance after grade four (Wassenburg et.al, 2008, p. 204).

The Role of Working Memory and Processing Speed in the Classroom

Research on how to teach so that students will remember what they are taught has been conducted for many years. Besides numerous research conducted on students' cognitive processes while learning from teaching, Winne, Marx, & Simon (1983) suggest that students can be trained to discriminate instructional stimuli and respond with pre-arranged cognitive strategies (p.244). For example, they suggest that students can learn from teaching as presently delivered in classrooms. In addition, a fundamental assumption of cognitive psychology is that learners actively construct mental representations of their environment, rather than passively react (p. 70-80).

Learning from teaching also suggests that there are two varieties of stimuli in instruction to which learners can respond cognitively (Winne, Marx, & Simon, 1983, p. 87-88). One such model, and used within this research, includes teachers/students (and other media for presenting curriculum material) cue learners to use particular cognitive strategies in order to accomplish learning. These are instructional stimuli. To profit from instructional stimuli, learners must accomplish three cognitive tasks (Winne, Marx, & Simon, 1983, p. 87-88):

1. To perceive instructional stimuli, (i.e. notice their occurrence and understand the cognitive operations or strategies intended to facilitate learning).
2. The student must carry out the cognitive activities to create or manipulate information that should be stored in memory as a representation to be learned.
3. They must encode this instruction/prepared content for later retrieval (i.e. on a test), with efficiency.

While teachers continue to develop professional skills in delivery of instruction to improve cognition and 21st century skills within the curriculum, other methods of cognitive interventions have been developed to improve students' ability to improve working memory and processing speed. A variety of studies have demonstrated gains in cognitive ability following cognitive training interventions through other methods. One such study with students in school, explored whether a computer school-based Cogmed Working Memory Training (CWMT) program would "improve both academic and psychological aspects of school performance" (Hitchcock & Westwell, 2017, p. 147). Primary school children with the mean age of 12 (N= 148) were clustered into three groups, to include active participation, a nonadaptive version of CWMT, or no training. Results from this research identified gains on trained tasks but not on working memory or attention capacity (Hitchcock & Westwell, 2017, p. 147).

Methodology

The study investigated a heterogeneously group of fourth grade students (N=14) and small heterogeneously group special education students (N=9) improve their cognitive ability through direct training and practice in working memory and processing speed through a self-design board game. The study was based on the premise that short intervention skills and supports, monitored at a minimum of twice a week, would lead to increased working memory and processing speed potential.

Research Question: Utilizing a self-design board game for intervention purposes, students will show an increase in:

1. Working memory with respect to their ability to attend, retain needed information, retrieve facts on demand, manipulate information mentally, and recall processes or concepts.
2. Processing speed with respect to their ability to fluently and automatically perform cognitive tasks, especially when under pressure to maintain focus, attention, and concentration.

Setting

The school district where this study was conducted is located in Central New Hampshire. According to the 2010 US Census Bureau, the city's population was 15, 951, with a projected 2017 population of 16,464 (U.S Census, 2010). This study took place in one of the three elementary schools that services students Kindergarten through grade 5. The current enrollment for the school is 302 students (as well as 26 part time pre-school students) with an average teacher to student ratio of 20 to 1. Of the 302 full time students, 47 percent are male and 53 percent female. 92 percent of students are White, 1 percent Black, 5 percent Latino, and 2 percent identify themselves as multi-racial. The number of students who receive free and reduced lunch at this elementary school is 50 percent.

Participants

The fourth-grade classroom teacher within this environment is a female with six years of teaching experience. She holds a Bachelor of Science Degree in Communication Sciences and Disorders. She also holds a Master of Education Degree in Elementary Education and Special Education. Two special education teachers participated in this research project with small group instruction. One special education teacher, with six years of teaching experience, has a Bachelor of Arts in Special Education with General Special Education Certification Kindergarten through grade 8 (K-8). The second special education teacher, with five years of teaching experience, has a Bachelor of Arts in Studio Arts with General Special Education Certification (K-8). The intent to conduct research in this fourth-grade classroom was due to expressed interest by a special education teacher and school psychologist to collaborate with regular education in providing interventions within a regular classroom setting and special education setting to improve cognitive skills.

Students who participated in this study include a fourth-grade heterogeneously grouped classroom, as well as a handful of other students who receive special education services from various grade levels. Of the participants in the regular education classroom included in the study (N=22), fourteen students (ages 9-11) participated with parent consent. Ten students (53 percent) were male and nine students (47 percent) were female. Three students were identified for special education services within this classroom. Six remaining students were in small groups within the special education setting. Three students were in a small group of instruction from the fourth grade, three students from the third grade, and two students from the first grade. Of the special education students who participated, three students are identified with a Specific Learning Disability, one student with an Other Health Impairment, two students with an Intellectual Disability, one student with Autism, and one with a Developmental Delay. Of these special education students, one student is medically diagnosed with Cerebral Palsy, another with a Hearing Impairment, and a third with Attention Deficit Hyperactivity Disorder (ADHD).

Consent

The Principal and building Special Education Administration of the research site interviewed the researcher(s). Once initial permission was granted, the researchers proceeded to the Superintendent, Assistant Superintendent, and the School Board. Once permission was formally granted, the study was conducted from March to May 2018. Participation was voluntary. Proceeding School Board approval, parental consent was obtained January-February 2018 through a parent letter. Within the regular classroom setting, three parents did not give consent for their child to participate in the study. Within the special education setting, six parents did not give consent for their child to participate in the study. Therefore, it was explained to those parents that no data would be collected however their child would still learn the strategies and skills taught as part of the game board instruction.

Independent Variable

The researchers began role-modeling game board directions/instructions at the end of February 2018. Within the experimental classroom twice a week, the intervention was to be played in small groups of two to four within the intervention time allotted (e.g. fifteen minutes)
For this study, the researchers developed a board game titled “Zip Zap Zoinks”. Multiple game plays were discussed and created, though only one was used for the purpose of this study. The spaces were labeled “Zip”, “Zap”, or “Zoinks” with a few spaces labeled “Move Ahead 1 Space” or “Move Back 2 Spaces”. The final space before the finish was labeled “Zoinks”. The spaces labeled “Zip”, “Zap” and “Zoinks” correlated with a skill card for either working memory or processing speed. The participant would begin on the first space, choosing the card that matched the space he/she was on. Once the task was completed accurately, the participant would roll two dice. He/She would move the number of spaces indicated on the dice and on his/her next turn, the participant would choose the card correlating to the new space.
“Zip” cards initiated a visual motor processing speed task. Each card had a series of images, letters, or numbers on the page. These items were placed in neat rows on some cards or scattered randomly with various sizes and fonts. Directions were given to put a slash through a particular item on the card (i.e.: “Put a slash through as many animals as quickly as you can.” or “Put a slash through as many numbers as quickly as you can.”) Participants were given 30 seconds to complete the task. As the research continued, 30 seconds appeared to be too much time and was modified to 15 seconds.

“Zap” cards initiated a verbal working memory task. A card may have a series of words or numbers ranging from a set of three to seven. The goal of the task is to repeat back the series of words or numbers in the order they were given. The cards were split into decks depending on how many items were on the card, so that the appropriate level could be chosen for the individual participants.

“Zoinks” cards also initiated verbal working memory tasks, however these cards required multi-step actions. Cards included items such as completing 4 step directions, listening to a short story and answering questions, and recalling a specific word (i.e.: the third word) in a list of six or seven words. In order to win the game, a participant had to complete a “Zoinks” task successfully.

The teacher continued the intervention throughout the remainder of the school weeks to provide generalization of skills. The research concluded the last week of May 2018.

Dependent Variables

Dependent variables were administered by a certified school psychologist and a researcher for this study. She has over 20 years of teaching experience (PreK to college level) and seven years as a school psychologist. The Wechsler Intelligence Scale for Children–Fifth Edition (WISC–V; Wechsler, 2014) is the latest version of one of the most widely used intelligence tests for children ages 6 to 16 (Watkins & Beaujean, 2013, p. 52). The WISC–V reflects current conceptualizations of intellectual measurement articulated by Carroll, Cattell, and Horn (Canivez, Watkins, & Dombrowski, 2015, p. 975-977). Two working memory and one processing speed subtest were utilized from the WISC-V for this research. Reliability and validity for measures administered are sound.

Working Memory Assessments

Letter-Number Sequencing- Letter-Number Sequencing measures attention span, short-term auditory recall, processing speed and sequencing abilities. The task involves listening to and remembering a string of digits and letters read aloud at a speed of one per second, then recalling the information by repeating the numbers in chronological order, followed by the letters in alphabetical order. Letter- Number Sequencing is an untimed core Working Memory subtest.

Arithmetic- Arithmetic measures numerical accuracy, reasoning and mental arithmetic ability. Arithmetic is a supplemental Working Memory subtest.

Processing Speed Assessments

Cancellation- Cancellation measures visual vigilance/neglect, selective attention, and speed in processing visual information. Cancellation is a timed supplemental Processing Speed subtest.

Data Analysis

Wechsler Intelligence Scale for Children- Fifth Edition (WISC-V) measures (Letter-Number Sequencing, Arithmetic, Cancellation) were converted from a raw score to a scaled score. A scaled score on the WISC-V indicates a mean of 10 and standard deviation of 3 for the subtest. A higher scaled score shows that a participant has a stronger cognitive (e.g. working memory or processing speed) ability. Scores of 8 to 12 are considered in the average range.

Results

Grade 4 Regular Education Classroom (N=14)

For this study, it was hypothesized that cognitive interventions would improve working memory and processing speed skills in participants. The mean and standard deviation obtained from the individual participants are based on pre- and post-testing. Table 1 reports the means and standard deviations for the three subtests administered using Excel and Statistic Suites.

Table 1

Differences in Means and Standard Deviations for Pre and Post-Test Subtests

	Pre-Test (N=14)		Post-Test (N=14)	
Measurement	M	SD	M	SD
Cancellation	9.64	2.95	9.35	2.85
Letter-Number Sequencing	9.21	2.72	10.71	3.40
Arithmetic	9.14	1.74	11.07	2.21

Note. Mean Scores are displayed as scaled scores. Standard Deviation scores are displayed as percentages.

The data in Table 1 show that the means for the Letter-Number Sequencing and Arithmetic post-tests are higher than the pre-test mean.

The Cancellation t-value was 0.24 (13) with a p-value of 0.81. The difference between the pre- and post-test is not significant at the .05 level. The results of the test are in Table 2.

The Letter-Number Sequencing t-value was -1.30 (13) with a p-value of 0.21. The difference between the pre- and post-test is not significant at the .05 level. The results of the test are in Table 2.

The Arithmetic t-value was -3.20 (13) with a p-value of 0.01. The difference between the pre- and post-test is significant at the .05 level. The results of the test are in Table 2.

Table 2
Independent Small-Sample Hypothesis Tests for Cognitive Testing

Subtest	t value	df	p value*
Cancellation	0.24	13	.81
Letter-Number Sequencing	-1.30	13	.21
Arithmetic	-3.20	13	.01

Note. Scores are displayed as percentages. *p <0.05, two-tailed.

Special Education Students (N=9)
For this study, it was hypothesized that cognitive interventions would improve working memory and processing speed skills in participants. The mean and standard deviation obtained from the individual participants are based on pre- and post-testing. Table 3 reports the means and standard deviations for the three subtests administered using Excel and Statistic Suites.

Table 3
Differences in Means and Standard Deviations for Pre and Post-Test Subtests

	Pre-Test (N=9)		Post-Test (N=9)	
Measurement	M	SD	M	SD
Cancellation	9.90	2.49	9.00	1.73
Letter-Number Sequencing	5.44	2.19	4.33	1.95
Arithmetic	5.11	1.23	6.33	1.74

Note. Mean Scores are displayed as scaled scores. Standard Deviation scores are displayed as percentages.

The data in Table 3 show that the means for the Arithmetic post-tests are higher than the pre-test mean.

The Cancellation t-value was .66 (8) with a p-value of 0.52. The difference between the pre- and post-test is not significant at the .05 level. The results of the test are in Table 4.

The Letter-Number Sequencing t-value was -0.87 (8) with a p-value of 0.40. The difference between the pre- and post-test is not significant at the .05 level. The results of the test are in Table 4.

The Arithmetic t-value was -1.40 (8) with a p-value of 0.18. The difference between the pre- and post-test is not significant at the .05 level. The results of the test are in Table 4.

Table 4
Independent Small-Sample Hypothesis Tests for Cognitive Testing

Subtest	t value	df	p value*
Cancellation	0.66	8	.52
Letter-Number Sequencing	-0.87	8	.40
Arithmetic	-1.40	8	.10

Note. Scores are displayed as percentages. *p <0.05, two-tailed.

Discussion

While we work on 21st Century skills within the classroom setting, educators must have an understanding of the constructs of attention, memory, and executive function, “all of which is critical to our understanding of human cognition and learning” (Lyon & Krasnegor, 1996, p. 1). Learning is dependent on the ability to pay attention to the environment; retain and retrieve information; and select, deploy, monitor, and control cognitive strategies to learn, remember, and think (Lyon, 1996, p. 3). Without these skills, “We cannot plan, solve problems, or use language” (Lyon, 1996, p.3) On top of this, we expect, in our culture, to do things quickly. Children who may not process information as quickly may have challenges in their thinking, appearing less intelligent in classrooms. For this study, it was hypothesized that a working memory and processing speed intervention would positively affect assessed cognitive skills. Post-test Performance Working Memory. The number of research articles accessed through regular search engines such as ERIC and Psych Info was low when comparing results. Most research has been conducted with earlier versions of the Wechsler Intelligence Scales for Children Third and Fourth Editions. What is available for cognitive results and the utilization of the WISC-V focuses on specifics of cultural and linguistic needs, such simplicity of administration, few verbal demand, and broad cross-cultural applicability. Results were positive for culturally diverse populations.

When interventions used to improve working memory were game oriented, computerized model interventions were dominant in the search engines. Van de Weijer-Bergsma, Kroesbergen, Jolani, & Van Luit (2015) research saw improvements in working memory through their online computerized and self-reliant assessment of verbal working memory in primary school children, particularly older primary children vs. younger primary children (p. 767). Results from this study are not consistent with earlier research. However, when each task was analyzed separately, participants' abilities within the regular education classroom increased in their ability to hold and manipulate information to mathematically problem solve. This is consistent with research conducted by Swanson, Jerman & Zheng (2008) in improvements in primary aged students' problem-solving ability. Their ability to repeat rote information remained consistent. Special Education participants working memory results remained consistent.

Post-test Performance Processing Speed. The number of research articles accessed through regular search engines such as ERIC and Psych Info was low when comparing results of game interventions. Results from this study are consistent with Wassenberg et al. (2008) in that processing speed continues to develop in the elementary school years (p. 206). The current study found that game interventions resulted in consistent pre/post test scores between all participants.

Discussion of Methodological Limitations

This study has multiple limitations. First, the sample size was large enough to produce results and run the proposed analysis, but it was too small to make strong statements on the effectiveness of the interventions. The sample was also from a single grade in a school district in central New Hampshire. Although this grade was chosen specifically because of the developmental level of children ages of nine to eleven, it does not provide a wide scope of ages or developmental stages.

In designing this study, the researchers selected only one classroom due to ease of gaining permission and implementation. Due to the specific demographics of the school and the classroom, the findings can most likely be generalized to children only in the same environment. The researchers also did not consider all grade levels in the special education setting. Due to the ease of implementation, the special education setting results can most likely be generalized to children in the specific grade, setting, and disability(s).

Additionally, this study did not control for students' initial reading levels for the working memory cards. Thus, it is not clear to what extent reading and comprehension skills contributed to the present findings. The same could be said for attention or impulsivity, or emotional issues. The inability to control for these individual differences that were unrelated to the purpose of the current study may have confounded the results in several ways.

When conducting the dependent variables, the same, consistent, quiet, and safe location was not utilized for all participants. This could have resulted in some variation and inconsistencies between pre and post test scores among all participants. When administering cognitive testing such as the WISC-V, guidelines state that subtests can only be administered once a year. This is to reduce the practice effect. The WISC-V was given twice within the research period. It, therefore, has to be questioned to what extent these data can be considered admissible, despite the strong reliability and validity of the WISC-V.

Several factors could have contributed to the inconsistency or lack of cognitive growth in working memory and processing speed scores as assessed. The intervention was determined to be conducted twice a week within the regular and/or special education setting. The study was conducted during the winter season. Besides a school vacation week interfering, snow days were called (minimum of five) during the research period, resulting in no school. If the snow day was called on the intervention day (i.e. game day), a make-up session may not have been conducted. No direct instruction on strategies (e.g. mental images, repetition of numbers/letters) was employed throughout the research, which could indicate no improvement in scores for working memory and processing speed. The classroom teacher and researchers only met once during the intervention period to discuss progress, although some positives and negatives were discussed, and addition of new and more challenging cards were administered based on this one discussion. Collaboration between regular education, special education, and the researchers were warranted and could have resulted in minimal growth noted on dependent measures.

The intervention (i.e. board game) within the regular classroom took place in small groups scattered throughout the classroom. Such a potentially noisy context might have been problematic for participants to participate fully.

This study does have a strength worth noting. Creating a board game for educators to use as an intervention through a warm-up session before direct instruction, an intervention period held during the Response to Intervention time, or through center time in a classroom, was highly regarded by special educators during a professional development session. Thoughts on improvements for the board game were sought by this group as well as the students in the regular education setting who participated in the study. This created a buy-in atmosphere to improve participation. This process helped the researchers scaffold skills in the game cards to meet developmental needs.

Implications

Elementary classrooms and small group special education settings, as described in this research, shows that interventions in cognition is important to improve learning. Future research that examines children's cognition and learning as potential mediators between the ability to pay attention to the environment; retain and retrieve information; and select, deploy, monitor, and control cognitive strategies are needed to learn, remember, and think. Further research with this age group and data collecting on academic achievement while collecting cognitive data would help inform educators of academic and behavioral gains, particularly if conducted over an academic year and possibly monitored over the course of subsequent years. The intent of the researchers is to continue this research topic and board game in the same school with another heterogeneously grouped grade four classroom in the fall of 2018 to late spring 2019.

The findings speak to the importance of teacher preparation in ways that promote working memory and processing skills while teaching. Most teacher preparation programs and professional development for certified educators offer classroom techniques that are not always tailored to children's cognitive needs or development. The present findings suggest that while teachers deliver daily instruction, they can infuse strategies and skills at an early age to at least maintain current abilities. Repetition and practice help students to make sense, meaning, and generalization of skills across the school environment(s). Re-teaching, review, and modeling of strategies is needed. This will require a commitment from teachers, students, and administrators who determine the amount of instructional time for subject areas.

Conclusion

All students need time to learn. Learning consists of reinforcing the connections in the brain called neurons. Educators can "supercharge" material to be learned by relating it to students' senses and experiences. These connections then in turn intensify their memory. The ability to complete tasks in a timely manner is highly related to a child's success in school. Students needs to learn strategies to not only improve academics, but to grow and develop socially, emotionally, and behaviorally. They need to understand how and when to implement cognitive strategies within the context of the school environment so that they experience positive development during a crucial time in their childhood. Increasing cognitive skills in children's development has shown to enhance adaptation, adjustment, and achievement throughout the life span (Lyon & Krasnegor, 1996, p. 392). The results of this study translate to effectively continuing to develop and maintain cognitive skills through the possibility of long-term intervention skills in working memory and processing speed skills among elementary students, improving the development of learning as early as possible.

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