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Editorial

Dear IEJEE Reader,

It's a great pleasure for me to present this issue of International Electronic Journal of Elementary Education (IEJEE) for you while COVID-19-pandemien threatens our civilization. Our daily working-routines, social interactions and social communication are negatively affected. Many businesses are closed and huge number of people lost their jobs. Children and students found themselves in unusual situations and exposed for unusual learning environments. They faced many different challenges that not any other generations experienced and thus many of us academicians felt us helpless, but thanks to ICTs that help us to provide acceptable conditions for their learning.

While the world is struggling with COVID-19, we witnessed to another virus in many countries and communities: Racism. COVID-19 is an epidemiological issue. An approved vaccine can prevent or solve the problem. This is not the case for racism, because it has its roots in history, in oppression, looting and slavery. It has to do with unjust power relations.

COVID-19 is an invisible enemy for all of us. Racism is invisible for some people, but not for those who exposed to racism and hit by. Racism looks like chameleon, it changes color in changing contexts and times. Racism is a combination of negative prejudice and negative power. Combination of negative prejudice and lack of use of positive legal power to prevent exercising negative power also results in racism. Black Lives Matter-movement reminded us that our civilization has several enemies.

Social distancing is necessary for spreading of COVID-19. Mental and moral distancing and legal measures are necessary to prevent and eradicate racism.

I would like to express my deepest gratitude to our peer reviewers, executive officers and technical staff of IEJEE.

Sincerely,

Prof. Dr. Kamil Özerk
Editor-In-Chef, IEJEE

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All responsibility for statements made or opinions expressed in articles lies with the author.

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Mathematical Problem-Solving Processes of Students with Special Needs: A Cognitive Strategy Instruction Model 'Solve It!'

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Abstract

Being a cognitive strategy instruction model called 'Solve It!' involves cognitive and metacognitive elements. The model was developed by Montague (1992) as one of the process-based teaching strategies. The purpose of 'Solve It!' strategy is to teach the following seven cognitive strategy steps: read, paraphrase, visualize, hypothesize, predict, calculate, and check. Each cognitive strategy step has the following three metacognitive steps: ask, say, and check. 'Solve It!' strategy has been used to teach students with special needs on how to solve word problems. This study aimed to evaluate the studies using 'Solve It!' strategies. Therefore, this study reviewed studies by examining electronic databases, journal indexes, and references part of relevant studies. A total of 48 studies were found. These studies were reviewed in terms of inclusion and exclusion criteria, and 12 of them were used for descriptive analysis. The findings of the study revealed that 'Solve It!' was effective in teaching mathematical problem-solving skills for students with special needs. The findings were discussed in line with relevant literature, and some suggestions for future research, and practitioners were presented at the end of the paper.

Keywords: Cognitive Strategy Instruction, Mathematical Problem Solving, Solve It!, Students with Disabilities

Introduction

Mathematics is defined as a symbolic language in which people can share their thoughts about the amount of something with each other (Miller, Butler, & Lee, 1998; Rivera, 1997). It is also considered a universal language throughout the world. Mathematics includes counting, measurement, arithmetic, computation, geometry, and algebra with the ability to think about situations related to a given quantity (Cawley, Parmar, Yan, & Miller, 1998). The following four fields were identified by National Council of Teachers of Mathematics (2000) as the basic mathematics fields: problem solving, reasoning, communication, and interaction with the real world. By defining basic mathematics components, the association considers problem solving as an important component of mathematics (Parmar & Cawley, 1997; Rivera, 1997). Although there are many definitions on the concept of problem solving, it is generally defined as a process that usually includes problem solving, combining, and analyzing skills (Cawley & Miller, 1986). Additionally, problem solving includes one and/or more than one step (Fuchs et al., 2004), and requires the differentiation of the calculations to be used in the solution process (Carpenter et al., 1993). The concept of problem solving may also contain information that is rarely unrelated or distracting (Passolunghi, Marzocchi, & Fiorillo, 2005).

Many models on the problem-solving process have been developed since 1945 (Krawec, 2010). Among them, Polya (1957), Mayer (1985), and Montague (1992) have been cited by several studies in the relevant literature using mathematical problem-solving models (Karabulut & Özkubat, 2019). The first mathematical problem-solving model was defined by George Polya in 1945. Polya's (1957) four basic steps proposed to solve mathematics problems are as follows: understanding the problem, planning, applying the plan, and controlling (backview). Another mathematical problem-solving model was developed by Mayer (1985). His model consists of two basic stages as follows: describing and solving the problem. Each step consists of four steps and two sub-steps (Krawec, 2010). These sub-steps are converting, merging, planning, and executing. The two problem-solving models have been considered important but are not described as 'innovative' in today's world (Sweeney, 2010). It is stated that in effective problem solving, the underlying power is metacognition defined as successfully completing a task and keeping track of him-/herself by being aware of his/her own thought processes with the control of his/her own performance (DeCorte, Greer, & Verschaffel, 1996). The problem solvers using metacognition strategies can plan effectively and monitor their own performance in the solution process (Montague & Applagate, 1993). In the context of this study, with the addition of metacognition strategies in the problem-solving process, problem solving was observed as a skill that includes not only cognitive processes but also the metacognitive processes. In this respect, Montague's problem-solving model provides a combination of cognitive and metacognitive strategies.

Montague (1991) stated that the model of effective problem solving in mathematics emerged as a result of her research on which the relevant effective variables in problem solving were examined. Those variables can be listed as follows: the usual problem solving, a solution of a mathematical problem, self-regulation, and successful problem solving (Montague, 1991). In this context, Montague (1991) examined the cognitive and metacognitive knowledge of problem solving, and the problem-solving processes of twice exceptional students, who have the combination of being gifted with superior ability and learning difficulties. In light of the study findings, cognitive and metacognitive strategies, and operations used by students who are proficient in problem solving were included in Montague's problem-solving model (Montague, Applegate, & Marquard, 1993). Montague problem-solving skills require the use of cognitive and metacognitive strategies and procedures (Montague, 1992). Montague (1992) defined the seven cognitive strategies and calculations to solve a prob-

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lem successfully and developed metacognitive strategies and calculations that enable the use of those cognitive calculations (Montague, Warger, & Morgan, 2000).

In this context, the 'Solve It! strategy developed by Montague is designed to improve the mathematical problem-solving performance of students with and without special needs (Montague, 1997). 'Solve It!' contains the elements of cognitive and metacognitive strategy teaching in mathematical problem solving and is a process-based approach used for students with learning disabilities (Daniel, 2003; Krawec, Huang, Montague, Kressler, & De Alba, 2013; Montague, 1984; Montague, 1992; Montague & Bos, 1986; Montague, Enders, & Dietz, 2011; Montague, Krawec, Enders, & Dietz, 2014), intellectual disabilities (Chung & Tam, 2005; Karabulut, 2015; Karabulut & Özmen, 2018), autism spectrum disorders (Whitby, 2012), and for spina bfida (Coughlin & Montague, 2011).

Students learn seven cognitive strategies and processes to solve mathematical problems effectively with the help of the first letters of cognitive strategies through the strategy of 'Solve It!': /read, paraphrase, visualize, hypothesize, estimate, compute, and check (RPV-HECC). Accurate realization of these cognitive processes is made possible by using the correct cognitive strategies (Montague, 1992). In the process of problem solving, cognitive strategy should be used to enable the cognitive process called 'understanding' to read a problem. Whether a problem is correctly comprehended by the students or not can be realized using 'paraphrasing the problem' cognitive strategy, and the use of 'conversion' cognitive process. Similarly, the use of the cognitive strategy 'calculation' needs to be applied in the cognitive process called 'computing' for a problem. While the metacognitive strategies are listed as self-instruction, self-questioning, and self-monitoring; the metacognitive processes are defined as the knowledge of strategy, the use, and control of it. In the model, the metacognitive strategies are not memorized with the help of a reminder, but they are only used to monitor students' own problem-solving practices (Montague, 1992). The cognitive and metacognitive strategies and processes are illustrated in Figure 1.

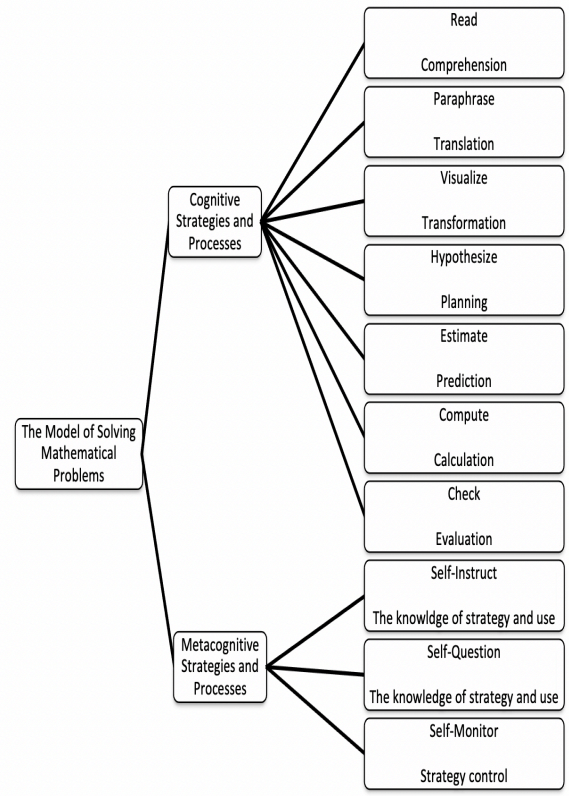

Figure 1. Montague Mathematical Problem-Solving Model

The 'Solve It!' strategy consists of a few steps and each step includes self-instruction, self-questioning, and self-monitoring strategies (e.g., say, ask, check). In other words, the 'Solve It!' strategy is a strategy that aims to teach the seven cognitive strategy steps, and three metacognitive strategy steps within each cognitive strategy steps. In this strategy, students are taught to read the problem carefully, express the problem with their own words, analyze the information, develop a plan, solve the problem, and control the solution (Reid & Lienemann, 2006). In this context, the strategy of 'say, ask, check' that involves the cognitive and metacognitive processes and strategies to solve a problem is presented in Table 1.

The 'Solve It!' strategy was first published as a book to support the curriculum of mathematics in 2003 (Montague et al., 2014). However, related studies were conducted long before 2003 (Montague, 1984; Montague, 1992; Montague & Bos, 1986). These studies claimed that 'Solve It!' strategy improved students' problem-solving performance by using different research designs such as experimental designs, single subject experimental designs, semi-experimental designs, and random clustering designs. The first study to test the effectiveness of the 'Solve It!' strategy was conducted by Montague and Bos (1986). The 'Solve It!' strategy was applied to six fourth-grade high school students with limited mathematical skills. The findings of the study using a multiple baseline design across individuals from single-subject experimental designs revealed that all participants' problem-solving performance were developed and that they were able to generalize their strategies to different and more difficult problems. Besides being the first study, the study was also important because it specified the cognitive strategy steps in the 'Solve It!' strategy. As a matter of fact, Montague (1984) mentioned eight cognitive strategy steps in the problem-solving process in her thesis. This strategy step is the 'state the problem' step that this study does not have in the current model. Following this research, the cognitive strategy steps remained valid, and the number of cognitive strategy steps taken in the 'Solve It!' strategy has been determined as seven. In the second study, Montague (1992) examined the effectiveness of the following two components: teaching cognitive and metacognitive strategies in the problem-solving process. Six middle school students with learning disabilities participated in the research. The intervention was completed in two phases. In the first stage, half of the participants participated in cognitive strategy teaching, while the other half participated in metacognitive strategy teaching. In the second stage, the participants participated in both practices. The research findings revealed that students who were taught cognitive strategies quickly went to the stage of mastery. In addition, problem-solving performance of all students involved in the study was developed in one-, two-, and three-step mathematic problems.

The 'Solve It!' strategy was used in the research conducted in the 2000s (Daniel, 2003), and it has gained momentum since 2010 (Krawec et al., 2013; Montague et al., 2014; Montague et al., 2011). Daniel (2003) examined the impact of 'Solve It!' strategy teaching on problem-solving performance of secondary school students with learning difficulties. Research findings showed that 'Solve It' strategy improved the problem-solving performance of students with learning disabilities and students' implementation levels of the strategies have increased. Krawec et al. (2013) examined the impact of the 'Solve It!' and the strategy knowledge of the students. In the study conducted on the 7th and 8th graders, the participant groups consisted of 77 students with learning disabilities and 83 students with average achieving students. Students with learning disabilities and average achieving students were divided into two groups: an individual intervention and comparison groups. The intervention process was conducted three days a week, and 30-minutes of problem-solving sessions were organized each week. The total implementation continued for six months. The research findings revealed that according to the Math Problem Solving Assessment-Short Form (MPSA-SF) pre-

Table 1. *The Strategy of 'Say, Ask, Check'*

Cognitive strategy and the steps of the operation	The metacognitive strategy 'say, ask, check'	Examples
Read (for understanding)	The aim of say (self-instruction): The student reads the question carefully before implementing an operation.	Say: I will read the question, and if do not understand it, I will read it till I do.
	The aim of ask (self-questioning): Has the student fully understood the question which has been directed to him/her?	Ask: Now that I have read the question, have I fully understood it?
	The aim of check (self-monitoring): If the student has understood the question, he/she can start solving it.	Check: I have understood the problem. Now I can proceed.
Paraphrase (your own words)	The aim of say (self-instruction):To state that he/she has understood, the student paraphrases.	Say: I will underline the words that are related to the problem. I will paraphrase the question.
	The aim of ask (self-questioning): Does the student have the ability to the question being asked to him/her?	Ask: Have I underlined the most important features or words in the problem?
	The aim of check (self-monitoring): Make sure that highlighted keywords are relevant.	Check: I have found the necessary words and features they will help me solve the problem.
Visualize (a picture of a diagram)	The aim of say (self-instruction): Students draw to reinforce their understanding of the problem.	Say: I will draw a diagram of the problem.
	The aim of ask (self-questioning): Is there any compatibility between the problem and drawing?	Ask: Do my drawings represent the problem?
	The aim of check (self-monitoring): The drawing includes visual key concepts related to the mathematics problem.	Check: The drawing contains the basic parts of the problem.
Hypothesize (a plan to solve the problem)	The aim of say (self-instruction): Student creates a plan for solving the problem.	Say: I am going to make a plan to solve the problem.
	The aim of ask (self-questioning): Which plan helps a student solve the problem?	Ask: What about the first step in this plan? What about the next step in the plan?
	The aim of check (self-monitoring): The plan is suitable for solving this problem.	Check: My plan has the necessary steps to solve this problem.
Estimate (predict the answer)	The aim of say (self-instruction): Student evaluates value for estimating the answer or uses other strategies.	Say: I will guess what the correct answer of the problem is.
	The aim of ask (self-questioning): Which prediction strategy does the student use to predict the answer?	Ask: In my estimation, which numbers can be used to solve the problem?
	The aim of check (self-monitoring): All of the important problem information was used to estimate the correct answer.	Check: I have not missed any important information in my estimation.
Compute (do the arithmetic)	The aim of say (self-instruction): Student will be able to follow the plan to calculate the solution of the problem.	Say: Do the operations in the right order.
	The aim of ask (self-questioning): Is the answer consistent with the prediction made?	Ask: How many steps are needed? Are the operations in the right order?
	The aim of check (self-monitoring): The steps in the plan were followed and completed in the correct order.	Check: I have done all the work in the correct order to solve the problem.
Check (make sure everything is correct)	The aim of say (self-instruction): Student reviews the calculation steps to verify the answer.	Say: I will review the steps of the calculation.
	The aim of ask (self-questioning): Did the student check all the steps to solve the problem and were all the calculations correct?	Ask: Have I reviewed every step in my answer and checked my work?
	The aim of check (self-monitoring): The problem solution seems to be done correctly.	Check: I have done all the steps in the correct order to solve the problem. If I have not done, I will check the previous steps, I will ask for help when I need to.

test and post-test results, the intervention group students started to use more strategies than the comparison group students. The average achieving group students compared to those with learning disabilities were reported to use different and more strategies in the problem-solving process. After the implementation, all students in the intervention group showed significant improvement compared to their peers in the comparison group.

Another study of Montague et al. (2011) examined the effect of the problem-solving intervention of 8th students with learning difficulties in problem solving. Forty schools were classified in the study according to their average mathematical performance and socioeconomic status. The group of participants consisted of 779 low and average achieving students, 78 of whom were with learning disabilities. Within the scope of the research, the students in the intervention group attended the training program on intervention three days a week and held weekly problem-solving sessions. The findings revealed that the mathematical performance of low and average level students with learning difficulties in the intervention program increased more than those of their peers in the comparison group. Moreover, Montague et al. (2014) examined the effect of 'Solve It!' interventions on the problem-solving performance of 7th grade students. The students who participated in the study were divided into the following three groups: low level, average level, and students with learning difficulties. They were examined in intervention and comparison groups according to their average mathematical performance and socioeconomic status. The group of participants consisted of 86 students with learning difficulties and 973 students with low and average achieving. Students who were in the intervention group participated in the following teaching stages: activating the pre-knowledge

for the implementation of the strategies and procedures required for problem solving, discussing the strategy, explaining the strategy, and describing how these strategies will help the improvement of the problem-solving skills, using the strategy appropriately with examples, using self-regulation strategies independently to follow their performance up three times a week for eight months until the problem-solving process was completed. The findings showed that the performance of the students in the intervention group increased compared to the peers in the comparison group, and especially the low achieving students' performance differed significantly compared to the peers in the comparison group.

Research on students with learning disabilities also revealed that the 'Solve It!' strategy was used to improve students' problem-solving performance and it was found as an effective strategy (Daniel, 2003; Krawec et al., 2013; Montague, 1984; Montague, 1992; Montague et al., 2014; Montague & Bos, 1986; Montague et al., 2011). Research showed that the 'Solve It!' strategy could be taught by clear expressions by following the generalization stages, being a model, voiced thinking, implementing guided and independent practices. It was also emphasized that cognitive and metacognitive strategies applied in problem-solving processes improve the mathematical skills of students with learning disabilities.

Studies have indicated that students develop problem-solving skills and generalize the learned strategy to other disciplines by systematically presenting and following the strategies of teaching steps (Smith & Alley, 1981). Some studies showed that process-based teaching is not only effective in helping students with different types of problems (Bennet, 1982) but also effective in improving students' abilities to express problems and self-instruction to develop problem-solving skills (Case & Harris, 1988). Based on these findings, it is safe to say that the 'Solve It!' strategy teaches students how to implement the problem-solving process and the strategies it includes because it is a process-based problem-solving strategy and designed to teach the metacognitive activities associated with each cognitive process (Montague et al., 2014). The results about the effectiveness of studies examining students with learning disabilities showed that the 'Solve It!' strategy should be implemented on the students with inabilities, such as autism spectrum disorder (Whitby, 2012), intellectual disabilities (Chung & Tam, 2005; Karabulut, 2015; Karabulut & Özmen, 2018), and spina bfida (Coughlin & Montague, 2011) to enable them to improve their problem-solving performance. Stating that the number of students with autism spectrum disorders increased faster than all other disabled groups, Whitby (2012) maintained that there is a need for effective teaching strategies that can be applied to students with autism spectrum disorders and analyzed the effectiveness of the 'Solve It!' problem strategy in solving math problems.

Three middle school students with autism spectrum disorders were included in the study in which multiple baselines were used across participants design. As a result of the ' Solve It!' strategy, the problem-solving performance of the three students examined by this study increased. In this respect, Whitby (2012) asserted that 'Solve It!' strategy was an effective intervention in the development of problem-solving processes for students with autism spectrum disorders. Additionally, Chung and Tam (2005) applied Montague's strategy (1992) by adapting the cognitive strategy teaching routines in their study with 30 students with mental disorders. In the study, the strategy teaching components developed by Montague (1992) (i.e., say, ask, and check) were adapted to the cognitive strategy teaching model (see Table 1). The students in the study were divided into three groups: traditional teaching, teaching via examples, and cognitive strategy teaching. It was revealed that the students in the cognitive teaching group made more progress than the students in other groups. Furthermore, Coughlin and Montague (2011) examined the effectiveness of the 'Solve It!' strategy to improve the math problem-solving performance of three students with spina bfida. The study used multiple baselines across individuals and included two steps of intervention. One-step mathematical problems were used in the first stage, while two-step mathematical problems were used in the second stage. According to findings, it appears that problem-solving performance of all participants have developed. Recent studies of Karabulut (2015) and Karabulut and Özmen (2018) aimed to examine the effect of the 'Solve It!' strategy on the problem-solving performance of students with mild intellectual disabilities. It was observed that these students changed their use, and control of their problem-solving strategies and information qualitatively; in addition, they were able to generalize the strategies they used to solve different types of problems and maintain the generalizations.

Studies on students with spina bifida, autism spectrum disorders, and intellectual disabilities revealed that the 'Solve It!' strategy is an effective strategy on (Chung & Tam, 2005; Coughlin & Montague, 2011; Whitby, 2012). Poor organizational skills, such as planning, remembering previous knowledge, and self-control, which are associated with the autism spectrum disorder, affect their problem-solving performance (Happe, Booth, Charlton, & Hughes, 2006). Similarly, students with intellectual disabilities are limited in solving problems by understanding and using mathematical concepts because of their inefficient strategy repertoires (Xin & Jitendra, 1999). The low level of attention and inability to decide on the proper computing types of students with spina bfida have a negative effect on their performance in their problem-solving processes (Burmeister et al., 2005). In light of these findings, it would be safe to say that the 'Solve It!' strategy provides support to these students on how to interpret a math problem, how to analyze given information, how to develop a logical solution plan to solve a problem, and how to evaluate alternative solutions.

Only limited studies have examined the effects of intervention programs applied to support the problem-solving performance of students with special needs in Turkey (Baki, 2014; Karabulut, 2015; Karabulut & Özmen, 2018; Karabulut, Yıkmış, Özak, & Karabulut, 2015; Kot & Yıkmış, 2018; Özsoy, 2005; Özsoy, 2017; Tuncer, 2009; Tufan & Aykut, 2018). In addition, there are no studies on identifying problem-solving processes of students with special (Özkubat, 2019; Özkubat & Özmen, 2018). The literature in Turkey on the 'Solve It!' strategy revealed that there are only two studies that aim to support the problem-solving performance of the students (Karabulut, 2015; Karabulut & Özmen, 2018). Therefore, a realization phase was reached on the importance of examining the studies related to the use of 'Solve It!' strategy, which is a mathematical intervention for students with learning disabilities, autism spectrum disorder, mental and physical disabilities in the international literature. Hence, planning the study, developing appropriate intervention programs and using scientific evidence in Turkey will be possible. This teaching strategy is only applied to mentally disabled students in Turkey; however, it is believed that this research will guide the use of this strategy to cover other types of disabilities, such as learning difficulties and autism spectrum disorders. In addition, this study will shed light on future studies by bringing a different perspective to the studies aiming to conduct on the 'Solve It!' strategy. In this respect, this study aimed to examine the studies using the 'Solve It!' strategy in terms of a number of variables.

Methodology

This study covers the research articles and dissertations published in journals using the applications of problem-solving interventions using the cognitive strategy teaching model 'Solve It!' including cognitive and metacognitive elements. This part of the stud presented the necessary information about the criteria for inclusion of the articles and theses in this study, the literature review, coding of the articles and theses, descriptive analysis process, and the reliability of the coders.

Criteria for Inclusion

For the inclusion and non-inclusion of the articles and theses in this study, The following basic selection criteria were determined: a) The research group should include students with special needs, b) the study should include the intervention of the 'Solve It!' problem-solving strategy as an independent variable and, c) the study should be published in a national or international peer-reviewed journal. Criteria for the inclusion of the theses are as follows: a) The participant group of the theses should consist of students with special needs, b) the theses should include the intervention of the 'Solve It!' problem-solving strategy as an independent variable and, c) the theses should be master's theses and/or doctorate dissertations. Studies that did not provide the findings of special needs students after the intervention strategies were not included in this study.

Search Procedures

First of all, EBSCOhost, Education Research Complete, Education Resources Information Center (ERIC), Web of Science, Psychological Abstracts Index (PsycINFO), ULAKBIM National Databases (UVT), ProQuest Dissertations & Theses Global, Google, and Google Scholar search engines were used to determine the articles. The search was performed by entering keywords in specified search engines. The keywords were typed in Turkish and English. The following keywords were used: The 'Solve It!' math problem solving, math intervention, cognitive strategy instruction, math instruction, computation, and algebra, arithmetic. As a result of the scanning with the aforementioned keywords, 48 studies were obtained. Titles, summaries, and keywords of the studies were analyzed, and six chapters were obtained by eliminating book sections, reports. In addition to this step, the articles containing problem-solving interventions were included in the following key journals between 1990 and 2018: Exceptional Children, Learning Disabilities Quarterly, Journal of Learning Disabilities, Learning Disabilities Research & Practice, Remedial & Special Education, and Journal of Special Education.

Secondly, the keywords used in determining the articles and theses were searched using the ProQuest Digital Dissertations search engine in Turkish and English. As a result of the literature review, two more studies were included. Both studies were doctoral dissertations. In the third and final steps, the aforementioned keywords were searched through the Council of Higher Education's National Thesis Center website to identify the graduate theses examining the 'Solve It!' strategy in Turkey; thus, one more study was included. Theses with electronic access were obtained from the Internet, and those with no electronic access were acquired from the libraries of the universities. The data were collected, and search filters were applied according to the Prisma Flow Diagram represented in Figure 2.

Article Coding and Reliability

The selection of articles and theses was made by considering the basic selection criteria for inclusion of articles and theses. First, a form has been created by taking the basic selection criteria into consideration. The first author read and examined 70% of the articles and theses in detail, while the second author read and examined 30% of them. They were then recorded in the assigned form. The review process was conducted by the first and second authors. As a result of the review, a total of 12 papers (nine articles and three dissertations) published in seven different journals that fit the pre-decided criteria were reached. Articles and theses included in the scope of the study are shown in the references part with (*). The reliability among coders in the study was calculated using the following formula: "Consensus / [Consensus + disagreement] x 100" by comparing the 25% of the research results and data obtained by the first and second researchers.

Descriptive Analysis Process

The articles and theses were examined in accordance with the research review form developed by the researchers to evaluate the data at hand, a) the number of participants, b) class and age, c) gender, d) diagnosis of participants, e) target skill, f) research pattern, g) environment of the ap-

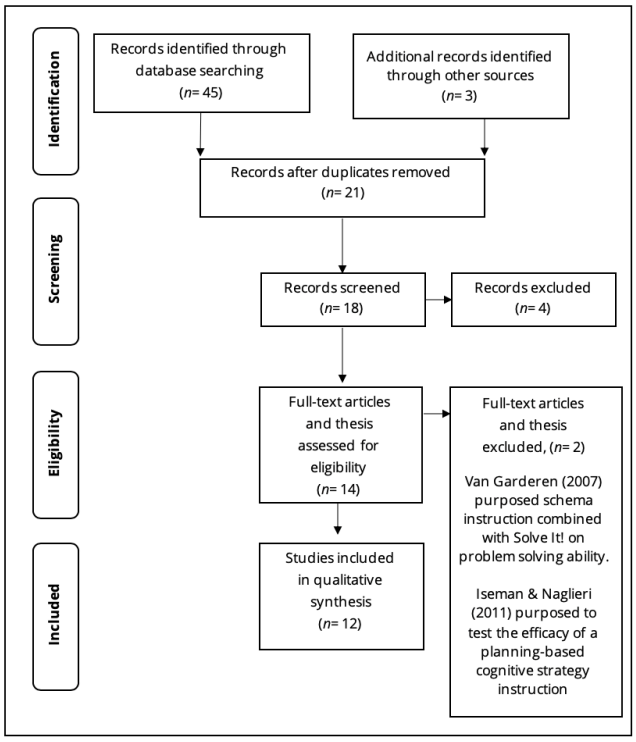

Figure 2. Flow Diagram (The PRISMA Statement)

plication, h) generalization and monitoring, i) reliability, and j) findings. Table 2 depicts the information regarding the studies investigated in this research.

Results

The results of these studies were analyzed through descriptive analysis and reliability.

Descriptive Analysis Findings

Participants

The studies included in this paper were examined in terms of the following variables: a) the number of participants, b) class and age, c) gender, and d) diagnostic variables. Demographic information is presented in Table 2. There are 2078 participants in the included studies: 3% of the participants (*n*= 58) were in the 8-12 age range, 0.4% (*n*= 9) in the 12-14 age range, 0.6% (*n*= 12) in the 15-19 age range, while the majority of the participants in the study did not specify their age levels (*n*= 1999, [96%]). More than half of the participants were girls (1130, [54%]) and 948 (46%) of them were boys. As for the grade level variables, 97% of the participants (n=2032) were at fifth-eighth graders (i.e., at middle school level), and that of %1 (*n*= 16) was at 9-12 graders. No information regarding participants' grade levels was included in 2% (*n*= 30) of the studies. When the participants were examined by diagnosis, it is observed that the majority of the participants are students showing typical development (*n*= 1766, [85%]). The other participants were students with learning disabilities (*n*= 269, [13%]), students with intellectual disabilities (*n*= 36, [1.6%]), students with autism spectrum disorders (*n*= 3, [0.2%]), and students with spina bfida (*n*= 4, [0.2%]).

Table 2. *Demographic Information of the Participants*

Variables		*f*	%
Age	8-12	58	3
	12-14	9	0.4
	15-19	12	0.6
	Non-defined	1999	96
Gender	Female	1130	54
	Male	948	46
Grade level	5-8. Grade level	2032	97
	9-12. Grade level	16	1
	Non-defined	30	2
Diagnosis	Learning disabilities	269	13
	Autism spectrum disorder	3	0.2
	Intellectual disabilities	36	1.6
	Spina bfida	4	0.2
	Typical development	1766	85
	Total	2078	100

Target Skills

The effectiveness of the 'Solve It! strategy, one-step problems (easy problems that can be solved in only one step), two-step problems (medium-level problems that can be solved in two steps), three-step problems (difficult problems that can be solved in three steps) was investigated in this study.

The Environments of Intervention

As can be seen in Table 3, the intervention environment of the research, the environment was distributed evenly. It appears that 27% of the studies (*n*= 3) were applied in support rooms, 27% of them were administered in education classrooms, and 27% of them were conducted in training support rooms initially and then in regular education classrooms. Besides, the intervention in two of the studies (19%), was performed in an empty classroom in the school.

Research Designs

Single-subject experimental patterns (*n*= 7, [58%]) and other experimental designs (*n*= 5, [42%]) were used by the reviewed studies. As for the research findings in terms of single-subject experimental designs, it appears that multiple baseline designs were used in four studies (33%) and multiple probe designs were used in three studies (25%). As for other experimental designs, it appears that the cluster-randomized design was used in two studies (17%), the pretest-posttest design was used in two studies (17%), and the cross-subject design was used in one study (8%).

Table 3. *The Environments of the Intervention and Information about Designs Used*

Variables		*f*	%
Single-subject experimental designs	Multiple baseline design	4	33
	Multiple probe design	3	25
	Total	7	58
Experimental designs	Cluster randomized design	2	17
	Pretest-posttest design	2	17
	Cross subjects design	1	8
	Total	5	42
Environments	Support room	3	25
	Education classroom	3	25
	Support room/ Education classroom	3	25
	Empty classroom	3	25
	Total	12	100

The Results of Effectiveness

The examination of the visual graphics and written findings of 12 studies revealed that the 'Solve It!' strategy was effective in the acquisition of the targeted skills. The findings of the examination of the graphs of single-subject experimental designs in which the 'Solve It!' strategy was discussed showed that the curves at the starting level had an increase slope in the intervention phases. In other experimental designs, it was revealed that when the 'Solve It!' strategy was applied as a result of statistical operations, it had an effect on the acquisition of target behaviors.

Reliability

The inter-coder reliability among coders for the descriptive analysis process was 92% and ranged between %90- %96.

Discussion

This research aimed to examine the studies using the 'Solve It!' strategy by different variables. The examination of the reviewed studies revealed the following three basic findings: First, it is effective to use the 'Solve It!' strategy for the problem-solving abilities of students with learning disabilities, autism spectrum disorders, spina bfida, and intellectual disabilities. Second, the strategy has the potential to lead to progress in the problem-solving abilities of students with and without disabilities. Finally, more studies should be conducted for the purpose of supporting the problem-solving skills of students with special needs.

The findings of the diagnostic variables, in line with the descriptive analysis findings, revealed that the majority of the participants with special needs were students with learning

disabilities. The limitations of the students with learning disabilities in the field of mathematics skills are considered as one of the main problems in the literature (Miller & Mercer, 1997; Montague, 1992). To solve the math problems, students need to read the problem, decide what to do, solve the problem, and check the logic of their answers (Montague, Warger, & Morgan, 2000). Similarly, in the 'Solve It!' strategy, students are able to understand the mathematical problems, analyze the information given in the problem, develop logical plans to solve the problem, and evaluate their solutions (Montague, Warger, & Morgan, 2000). Therefore, it would be safe to say that the 'Solve It!' strategy improves the students' problem-solving performance.

The processes are complex and sequential in problem-solving stages. In other words, the right solution requires the correct implementation of the previous step makes this process difficult for students with special needs (Jitendra et al., 2009). Likewise, in this research the 'Solve It!' strategy includes the following steps: how to solve the problem, how to interpret the problem with their own sentences, how to analyze the information, how to develop a plan, how to solve the problem, and how to check the solution (Montague et al., 2014; Montague et al., 2011; Krawec et al., 2013). These steps are sequential with each other (Reid & Lienemann, 2006). In addition, the teaching of metacognitive strategies is associated with each cognitive process. Thus, students learn to manage the process by using these strategies.

Solving math problems is considered a difficult skill for many students because of the complexity of the problem-solving processes (Jonassen, 2003; Schurter, 2002). The examination of the problem-solving teaching practices revealed that the sequential steps that students have to take to solve the problem are used and these steps do not cover the whole problem-solving process all the time (Montague, 1992). Although the stages representing this process show the students the way to solve the problems, some steps are not taken in practice and the metacognitive strategies which are used to get self-monitoring and self-evaluation conducted during the problem-solving process are not discussed thoroughly. It is not enough to know these stages to be a good problem solver, especially for students with difficulties in learning and managing their own learning processes, and for those with limitations in their cognitive processes. So as to say, the 'Solve It!' strategy enables students to learn the problem-solving process through the steps involving the entire process and the strategies to be used in these steps. The purpose of the cognitive strategy teaching is to teach students to think and act like good problem solvers or strategic learners (Montague, 2008). The cognitive routines used in this teaching technique are conveyed to students through loud thinking models, enabling the students' strategy applications to be independent thanks to the appropriate support, and immediate feedback on student's performance provided through student and teacher interaction (Güzel-Özmen, 2008). Students with special needs feel the need to organize their own thinking processes (Krawec et al., 2013; Montague et al., 2011; Montague et al., 2014). In this context, one of the important components of the 'Solve It!' strategy is supporters that can be expressed as procedural facilitators (Chung & Tam, 2005; Montague, 2008). The master problem solver's application of the strategy steps by thinking loudly serves as a bridge between the students' existing skills and knowledge and their intended target (Güzel-Özmen, 2006). The support provided at the beginning of the strategy education is gradually withdrawn, and finally, the student is able to implement the strategy independently (Chung & Tam, 2005). Another important concept in the 'Solve It!' strategy is the visualization strategies. The visual strategies presented by students with special needs, by organizing and presenting problem-solving steps to provide information about the problem due to the difficulties in coordinating the working memory, are of great benefit in solving the problem (Geary, 2004; Hughes et al., 2003). Accordingly, visualization in the 'Solve It!' strategy increases the students' understanding of the problem by bringing various information together in the problem (Ives, 2007; Jitendra et al., 2009; Van Garderen, 2007). In addition to the fact that the visualization of the problems enables students to solve the problems (Ives, 2007; Van Gardener, 2007), it is also stated that this ensures that the information will be stored and thus accelerate the processing of information by supporting the working memory (Keeler & Swanson, 2001). Short term memory problems of the students with special needs include the problem of bringing information back to their minds immediately after hearing or seeing information while the working memory problems arise from grouping information and cognitive processing faults, such as coding (Chung & Tam, 2005; Swanson & Jerman, 2006). In light of this information, it can be stated that students with learning disabilities can facilitate their math problem-solving processes by using the problem visualization strategy and supporting their memories. Many students with special needs face failure in the field of mathematics (Jonassen, 2003). Therefore, they can develop negative attitudes toward learning mathematics and use their existing potentials (Montague, 1997). The effect of perception, attitude, and motivation about learning mathematics cannot be disregarded because the student thinking that he/she cannot do this, simply does not try to achieve it (Karabulut & Özmen, 2018). Accordingly, it also supports the students in developing positive perceptions about problem solving through their implementation of the strategies in the 'Solve It!' strategy. Indeed, studies using the 'Solve It!' strategy (Daniel, 2003; Montague, 1992; Whitby, 2009) revealed that there is a relationship between the increase in the number of problem solving and the increase in the performance of the applying the strategy, and the attitude. It has been found that different teaching strategies develop the attitude toward mathematics and mathematics problem-solving approaches positively. It was also stated that there is a relationship between problem-solving performance of students with learning disabilities, and the difficulty level of the problem (Bryant, Bryant, & Hammill, 2000; Powell, 2011).

When faced with difficult problems, students with learning disabilities are not able to organize the information in their minds because they are limited in understanding the language used in the problem. Also, the multi-staged problems cause more confusion to these students in the problem-solving process (Powell et al., 2008). Research findings regarding target skills reveal that the problems used in related studies are the same problems included in the 'Solve It!' strategy. The problems used in the 'Solve It!' strategy range from easy to difficult (one, two, three-stepped) in terms of difficulties and the number of operations needed. In accordance with this information, students' problem-solving strategies can be developed by arranging the problems to be used in this intervention group of students with learning difficulties wisely (Hunt and Vasquez, 2014). In light of this information, it can be stated that the difficulties of the problems within the 'Solve It' strategy, and the number of transactions listed from easy to difficult (one, two, three steps) are an important variable for the effective implementation of this strategy (Karabulut & Özmen, 2018).

The participating groups of the study included students with learning disabilities, intellectual disabilities, autism spectrum disorders, spina bfida, and typical developmental patterns. The effectiveness of 'Solve It!' strategy applied in these studies has been evaluated (Chung & Tam, 2005; Coughlin & Montague, 2011; Daniel, 2003; Karabulut, 2015; Karabulut & Özmen, 2018; Krawec et al., 1984; Montague, 1992; Montague et al., 2011; Montague et al., 2013; Montague et al., 2014; Montague & Bos, 1986; Whitby, 2012). It was found that students with and without special needs made improvement. The intervention group showed rela-

tively positive developments over the control group in several reviewed articles. This means that many of the students benefited from the intervention. It also revealed that their peers with usual developmental patterns benefited from the strategies as well, even though it was prepared for the students with special needs. Based on the findings of this research, this research makes suggestions for practice and further research. First, the studies revealed that students with special needs succeeded in solving problems by applying appropriate interventions. In this context, experts working with students with special needs should get involved in professional development programs about the problem-solving stages as well as cognitive and metacognitive strategies with which students can successfully implement the problem-solution strategies. Second, it appears that 12 studies used the 'Solve It!' strategy to develop the problem-solving skills of students with special needs. Hence, students with special needs should be the subjects of the studies examining the 'Solve It!' strategy to support their problem-solving skills. In this context, future studies can test the effect of each of cognitive and metacognitive strategy element within the 'Solve It!' strategy and examine the effects of this strategy on problem-solving performance of the students with special needs. Thus, some programs can be prepared to solve the problems. Third, the 'Solve It!' strategy can be recommended not only for students with special needs, but also for their peers with similar development disorders because it has the potential to increase their problem-solving performance.

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* See Table 4.

Table 4. *Research Properties*

Research and aim	Participants	Grade and age level	Diagnosis	Target skills	Research designs	Intervention environment	Generalization and follow up	Reliability	Results
Chung and Tam (2005) Aim: Examined the effects of different approaches to teaching learners with mild intellectual disabilities to solve mathematical word problems.	22 Male 8 Female	GL: - AL: 8-12	ID	Mathematical problems including two steps addition and subtraction	Cross subjects experimental design	Empty room in school	G:- F:-	RO: + AR: -	Students who were trained in cognitive strategy teaching solved more problems than other groups correctly.
Coughlin and Montague (2011) Aim: Investigate the effects of cognitive strategy instruction on the mathematical problem solving of three adolescents with spina bifida.	3 Male 1 Female	GL: 9-10 AL: 15-17.	SB	One and two-step mathematical problems in the Solve It! program	Multiple baseline across individuals design	Support room	G:- F: +	RO: - AR: +	The mathematical problem-solving skills of all participants in the study increased significantly.
Daniel (2003) Aim: Investigate the effects of cognitive strategy instruction on the mathematical problem-solving performance of middle school students with learning disabilities.	12 male 6 female	GL: 6, 7, 8 AL: 11-13	AA, LD, TD	Math problems in Solve It! program	A quasi experimental, control group time series design	Support room	G:- F:+	RO: - AR: -	Mathematics problem-solving performance of students with learning disabilities improved.
Karabulut (2015) Aim: Evaluate the impact of Solve It! intervention in solving mathematical problems.	1 male 2 female	GL: 5 AL: 11-12	ID	Substitution problems involving one step addition and subtraction	A multiple probe design across subjects	Empty classroom in the school	G:+F :+	RO: + AR: +	'Solve it' strategy was identified as effective in the solution of change problems involving a gradual addition and subtraction process.
Karabulut and Özmen (2018) Aim: Examine the effects of Solve It! Strategy on change problems.	1 male 2 female	GL: 5 AL: 11-12	ID	Substitution problems involving one step addition and subtraction	A multiple probe design across subjects	Empty classroom in the school	G:+ F:+	RO: + AR: +	'Solve It!' strategy was effective in teaching students with mild intellectual disabilities solving change problems including one-step addition and subtraction, they maintained their skills and generalized their skills to different problem types, two-step change problems.
Krawec, Huang, Montague, Kressler and De Alba (2013) Aim: Investigate the effectiveness of Solve It! instruction on students' knowledge of math problem-solving strategies.	82 male 79 female	GL: 7, 8 AL:	AA, LD, TD	Math problems in the Solve It! program	Pretest posttest design and structured interviews	Education classroom	G:- F:-	RO: + AR: +	Students participating in the intervention program used problem-solving strategies more. Students with learning disabilities use relatively little strategy than their peers while solving problems.
Montague (1984) Aim: Investigate the effectiveness of an eight-step strategy designed to enable students to read, understand, carry out, and check verbal math problems that are encountered in the general math curriculum at the secondary level.	5 male 1 female	GL: 10,12 AL: 15-19	LD	One, two and three step mathematical problems	A multiple baseline design across individuals	Support room and education classroom	G:+ F:+	RO: + AR: +	Mathematics problem-solving performance of students with learning disabilities has improved.
Montague (1992) Aim: Investigate the effect of cognitive and metacognitive strategy teaching on solving mathematical problems.	3 male 3 female	GL: 6,7,8 AL: 12-14	LD	One, two and three-step mathematical problems with exact and decimal numbers	A multiple probe design across subjects	Support room	G:+ F:+	RO: - AR: -	It is stated that the model in which cognitive and metacognitive strategies were taught together in solving mathematical problems was more effective than the models in which the strategies were handled separately and teaching cognitive and metacognitive strategies improved the performance of the students in solving mathematical problems.

Table 4 (Cont.). *Research Properties*

Research and aim	Participants	Grade and age level	Diagnosis	Target skills	Research designs	Intervention environment	Generalization and follow up	Reliability	Results
Montague and Bos (1986) Aim: Investigate the effect of an eight-step cognitive strategy on verbal math problem-solving performance of six learning disabled adolescents.	5 male 1 female	GL: 10,12 AL: 15-19	LD	One, two and three-step mathematical problems	A multiple baseline design across individuals	Support room and education classroom	G:+ F:+	RO: +AR: +	Mathematics problem-solving performance of students with learning disabilities improved.
Montague, Enders and Dietz (2011) Aim: Improve mathematical problem solving for middle school students with learning disabilities by implementing a research-based instructional program in inclusive general education math classes.	359 Male 420 Female	GL: 8 AL: -	LD, TD	Mathematical problems with exact and decimal numbers	Cluster randomized design	Education classroom	G:+ F:+	RO: + AR: +	Students who participated in the intervention in all talent groups received higher points.
Montague, Krawec, Enders and Dietz (2014) Aim: Evaluate the impact of "Solve It!" intervention in solving mathematical problems.	453 male 606 female	GL: 7 AL: -	LD, TD	Mathematical problems with exact and decimal numbers	Cluster randomized design	Education classroom	G:+ F:+	RO: + AR: +	Students who participated in the intervention in all talent groups received higher points.
Whitby (2012) Aim: Investigate the use of the Solve It! Problem Solving Routine for students with autism spectrum disorders.	2 male 1 female	GL: 7, 8 AL: 13-14	ASD	One and two-step mathematical problems in the Solve It! program	A multiple baseline across participants	Support room and education classroom	G:+ F:+	RO: + AR: +	It is stated that all of the three students who participated in the study improved their performance in solving mathematical problems.

Keys: AL: Age Level; GL: Grade Level; LD: Learning Disability; ID: Intellectual Disabilities; SB: Spina Bfida; ASD: Autism Spectrum Disorders; TD: Typically Development G: Generalization; F: Follow Up; RO: Reliability of Observers; AR: Intervention Reliability.

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The Effects of a Site-based Teacher Professional Development Program on Student Learning

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Abstract

A mixed methods study is used to investigate the effectiveness of a professional development program intended to enhance teacher knowledge and student learning so as to systematically improve student achievement in elementary literacy. In this study, a large urban school district partnered with a local university to provide intervention in a Title 1, low-performing elementary school. Measures included teacher knowledge and practices based on surveys, classroom observation, and student achievement data. Teachers self-reported their perspectives on school-based teacher training in terms of its significance, requirements, challenges, and possible solutions to teacher training. Schools were selected based on their Adequate Yearly Progress (AYP) in reading/ language arts' status. Adequate Yearly Progress (AYP) is a measurement defined by the federal No Child Left Behind Act that allows the U.S. Department of Education to assess the academic performance of every public school and school district in the country by using the results on standardized tests. The collaboration effort involved supporting the school's goal of enhancing reading, language arts, and math achievement of students by providing interventions targeted toward grades four and five.

Keywords: Teacher Training, Professional Development, Elementary Education

Introduction

The paper features a school district's collaborative effort with an institute of higher education to provide professional development programs to build teacher capacity and thereby improve student learning. Increasingly, research confirms that teacher and teaching quality are the most powerful predictors of student success. As Linda Darling Hammond says, "we can have all kinds of educational reforms underway in the US - curriculum reform, governance reforms and so on; but at the end of the day, if you don't have a strong, qualified teacher in the classroom, nothing else in education can work" (Darling-Hammond and Oakes, 2019). By investing in teacher development, districts assure higher student achievement. School divisions are constantly making significant efforts to retain teachers by providing teacher development opportunities. Customized, sustained professional development programs that align with the needs of both the schools and the staff is an important means of retaining high-quality teachers. Professional learning culture must be fostered in the school to create and sustain the dynamics of ongoing learning. Although professional development is a viable and effective way to improve student achievement in reading, old models consisting of single workshops presented by outsiders that lack an in-depth understanding of the school, community, and the curriculum are not effective enough for today's teachers and students. In this study, an American university's College of Education faculty members helped provide various professional development and other activities for staff and students at a local elementary school. This collaborative effort was aimed at supporting the school's goal of enhancing reading, language arts, and math achievement of its students by providing interventions that were targeted at grades four and five.

Research on Continuing Sustainable Professional Development

The need for robust and systematic teacher preparation and development has gained increasing momentum. Various research studies have highlighted the benefits of training that targets the professional development of in-service teachers with the goal of improving teacher quality (Day, 2002; Niemi, 2015). Research clearly indicates that the quality of teaching has a significant impact on the learning quality of students (Anderson, Hiebert, Scott, & Wilkinson, 1985). Having highly qualified teachers in the classroom "does more to assist students who are academically at-risk than any other policy-controllable issue" (Denson, 2001, p. 34), including smaller student-teacher ratios (Darling-Hammond, 1999; Fuller, 1999). High-quality professional development training positively influences student achievement in general, including student achievement in reading (Wharton-McDonald, Pressley, & Hampston, 1998). As a result, school districts frequently utilize professional development training to improve reading instruction as well as student learning (Kinnucan-Welsch, Rosemary, & Grogan, 2006). In providing professional development training for reading, it is imperative that school districts have a clear framework for designing and implementing such programs.

Student achievement is clearly influenced by the capacity of the individual classroom teacher (Youngs & King, 2002). Students entering school from economically disadvantaged homes are more likely to have difficulty developing early literacy skills, leading to poor academic performance. As teachers realize that their instruction can have a direct impact on student learning outcomes, they often become motivated to strive for excellence in their instruction. This motivation improves the quality of teaching, resulting in greater student achievement. Results of various studies support this push for improved teacher professional development to, in turn, improve student academic performance (Kinnucan-Welsch, Rosemary, & Grogan, 2006).

The impact of a teacher's strong knowledge base and effective teaching skills on student test performance is evidenced by statistically significant correlations across multiple states (Darling-Hammond, 2000). In addition, research supports the need for improved teacher preparation due to low efficiency or low-quality teacher education programs. Teachers are constantly given additional tasks, and their workloads are increasing due to increasing state standards and pressure

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to promote effective change in student achievement. However, these expectations are arguably difficult for a teacher to achieve without proper training or professional development. This study was an attempt to support a school's goal of improving its students' reading, language arts, and math achievement. This was done by training both pre-service and in-service teachers in language arts, reading, and math competencies, with a focus on the interventions targeted toward students in grades four and five.

Research Methodology

Research Questions

The present study investigates the effects of school-based teacher training on teachers' base knowledge, using a cohort of twelve teachers who were given university-led courses and workshops. The following three questions were used to guide the research study:

- How well did teachers master the content and skills covered during the professional development activities?
- To what extent were the content and skills covered during the training implemented in the fourth and fifth grade classrooms?
- How did the fourth and fifth grade students perform on measures related to reading achievement after their teachers went through the professional development training?

Research Design

The mixed method evaluation design used both qualitative and quantitative data to examine participant perceptions and experiences, methods of instruction, and student achievement. To that end, we relied on various data sources to address the research questions outlined above. These sources included teacher questionnaires, teacher grades in the course, classroom observations, and student achievement scores related to reading. The study analyzed data from the teacher participants, classroom observations, and analysis of student achievement data.

School Demographics and Participants

The school that participated in the study was a Title 1 school with 780 students enrolled. As many as 98% of the students were African American and 95% received free or reduced-price lunch (a determining factor toward Title 1 eligibility). Based on the state's Standards of Learning (SOL) test scores, the school had been accredited with warning for the last two years. Schools with this rating receive extra help to improve their standing by developing a two-year improvement plan with the assistance of local agencies. In order to be fully accredited, an average of 70% of the students enrolled in the school must pass the SOL tests in each subject area at each grade level. Table 1 shows the SOL scores from the previous two years by grade level and subject area. The scores show that the criteria for full accreditation was not met across multiple subject areas and grade levels.

Target grade levels for the study were fourth and fifth grade students with 12 full-time teachers from the school also participating in the study. Three university instructors provided teacher training workshops and courses on Reading and Math. Table 1 shows the consistent low performance of the school's third and fifth graders, which are the two grade levels in which students are tested for state Standards of Learning (SOLs). It is evident from the table that the average scores in subject areas such as English, Math, History, Science, Writing, and Technology are significantly below state averages.

Table 1. *Percentage of Students by Grade Level, Subject Area, and Year Who Passed SOL Tests at the Selected School Compared to State Averages*

Grade/ Subject	Year 1 State Avg.	Selected School	Year 2 State Avg.	Select-ed School	Year 3 State Avg.	Selected School
			Grade 3			
English	60.74	32.63	64.39	46.39	71.63	69.15
Math	71.33	33.33	77.14	57.14	80.39	63.16
History	65.12	26.60	71.84	45.36	76.28	72.58
Science	72.58	32.63	73.92	38.14	78.16	67.74
			Grade 5			
English	68.38	32.11	72.89	39.56	77.73	49.37
Math	63.27	7.48	66.61	18.68	71.08	35.80
History	51.17	3.19	62.73	9.68	72.15	47.67
Science	64.14	11.01	74.72	33.70	76.06	43.37
Writing	80.57	41.12	84.31	45.56	83.58	68.29
Comp./ Tech.	85.04	44.95	82.11	40.22	86.18	44.30

Intervention

During the fall semester, university faculty taught a reading course titled Survey of Reading Instruction for three hours once a week during evenings. The teachers in the participating school were given priority enrollment, tuition waivers, and the opportunity to earn three graduate level course credits. This was a foundational level course in literacy education. Of the 30 candidates enrolled in the course, 12 teachers were from the target school where the intervention took place. A list of course competencies appears in table 2.

Table 2. *List of Course Competencies*

1	Identify major theories, models, current research and instructional practices in reading education
2	Demonstrate understanding that reading should be taught as a process
3	Discuss cultural and diversity issues as they relate to literacy learning
4	Demonstrate an understanding of phonemic, morphemic, semantic, syntactic and pragmatic systems of language and their relation to the reading, writing, and spelling processes
5	Demonstrate and make application of a clear understanding of emergent literacy, phonemic awareness, and phonological awareness
6	Demonstrate an understanding of the role researchers in the fields of education, linguistics, psycholinguistics, socio-psycholinguistics, and psychology have played in literacy instruction and learning
7	Discuss literacy as a learning tool across the curriculum
8	Discuss effective strategies for including parents as partners in the literacy development of their children
9	Discuss, explore, and apply effective strategies for vocabulary and comprehension development
10	Discuss and apply effective questioning strategies and techniques
11	Work in collegial groups for decision-making and support
12	Reflect on readings, practices, and student responses to literacy strategies concerning the impact on learning
13	Discuss issues relating to critical literacy such as the role of the reader and teacher in reading a text, gender, cross-cultural perspectives, intergenerational literacy, etc.
14	Apply effective strategies in teaching & assessing reading
15	Critically examine the role of technology in reading instruction and demonstrate application for enhancing literacy instruction
16	Formulate own literacy philosophy as life-long learner and professional

In addition, two professional development workshops were offered. Two workshops, one each semester, were conducted on early release days so that the teachers were available. Throughout the academic year, there were more than twenty other workshops and follow-up sessions provided by university faculty at the school site during the universal planning time for the fourth grade and fifth grade teachers. Nearly all of the fourth and fifth grade teachers attended each of the respective sessions. In addition, the school principal, reading specialist, and special education teachers were frequently in attendance.

Most of the topics covered during these professional development workshops led by faculty members at the university focused on classroom reading education strategies. The university faculty members informally surveyed the teachers and administrators on their curricular needs and requests. Based on these responses, two series of workshops were conducted on classroom math and technology strategies, which were identified as the teachers' curricular needs. One example of a topic covered in a technology workshop was the Inspiration software package. A list of specific topics covered in the three domains of Reading, Mathematics and Technology during the workshops appears in Table 3.

Table 3. *Topics Covered in Professional Development Workshops*

Reading	Math	Technology
Pre-learning concept checks	Pattern blocks for functional relationships	Inspiration for brain-storming activities
PAR (Preview, Assist, Reflect) lesson framework	100 board for patterns, LCM, GCF	Inspiration for pre-writing activities
Anticipation guide	Data based decision making with SOL scores	Microsoft Word for "how to sheets"
Two column note-taking	Data based decision making with Flanagan	Using Screenshots in Microsoft Word
Steps in cooperative reading		Using Draw in Microsoft Word
Interactive Cloze		Internet searches
PreP strategy		Using existing Webquests for content

Data Analysis and Findings

Teacher Course Questionnaire

Two questionnaires were developed to gain feedback from participating teachers. The first questionnaire was administered to teachers who were enrolled in the reading course. The second was administered to all fourth and fifth grade teachers from the participating school who were also enrolled in the course. The questionnaires provided both quantitative and qualitative responses. Limitations of this self-reported data were noted. Descriptive qualitative classroom observations were conducted in all fourth and fifth grade classrooms to corroborate this measure. In addition to the input from the teacher surveys, a measure of course grades provided additional information on how well the teachers mastered the course competencies.

The questionnaire on the reading course (Survey of Reading Instruction) was administered to teachers on the last day of class at the end of fall semester. The teachers were assured that their responses would remain confidential and the instructor would not have access to the questionnaire. All 12 of the participating teachers responded to the questionnaire.

For each of the twelve course competencies, teachers were asked to rate how well they mastered the competency and applicability of the competency to their classroom instructional practices. The five-point, Likert type, rating scale for mastery ranged from ''Not at all" (1) to "Very well" (5). The rating scale for applicability to the classroom ranged from ''Not at all" (1) to "Very or highly" (5). The second page of the questionnaire contained three open-ended questions and one checklist question. The two open-ended questions asked teachers to describe how the course changed the way they think about reading instruction and the way they teach reading. The final open-ended question solicited any other comments that would help us evaluate the course. On the checklist question, teachers were instructed to "check all that apply" to indicate whether they would be interested in (1) other reading courses, (2) workshops or other professional development opportunities related to reading, and/or (3) reading more professional articles or books related to reading. A copy of the questionnaire appears in Appendix A.

Mastery Ratings

The results of teacher ratings related to how well they thought they had mastered the course competencies are provided in Table 4. The average (mean) ratings were high across all twelve of the competencies, ranging from 4.17 to 5.00. The percentages by response category reveal that all teachers indicated at least some mastery of the competencies with most teachers indicating that the competencies had been very well mastered. The mean rating of 5.00 for three of the competencies (reading taught as a process; phonemic, morphemic, syntactic, and pragmatic systems; literacy as a learning tool across the curriculum) indicate that 100% of teachers thought these competencies were "very well" mastered. One competency that received relatively lower ratings (M= 4.17) was for "Strategies for including parents as partners in literacy development." Twenty-five percent of teachers said this competency was only "somewhat" mastered.

Applicability Ratings

Similar to the pattern of results obtained for mastery, the mean rating results observed for the applicability of course competencies to classroom instructional practices were also consistently high as shown in Table 4. For two of the competencies (Vocabulary strategies for comprehension and development; Questioning strategies and techniques), the mean rating of 5.00 was even higher than that obtained for mastery. In addition, the mean rating of 5.00 was again obtained for the same two competencies as observed for mastery (Reading taught as a process; Literacy as a learning tool across the curriculum). Again, a relatively lower mean rating of 4.17 was obtained for the competency, "Strategies for including parents as partners in literacy development."

Open-ended items

Ten of the twelve teachers responded to the first open-ended item which asked how the course changed the way they think about reading. The responses were very favorable in tone, and all responses indicated that their thinking about reading had changed as a result of the course. Some stated that they were more knowledgeable about how to apply different types of reading strategies and techniques in their classrooms. One stated, "The course has made me excited about the different strategies to teach reading.'' Another teacher said that she must "decide if the teaching techniques are benefiting the students" and if not, "find other strategies that work." Others appreciated the new knowledge and insights gained from the course. "The balanced literacy framework has given me different insights about teaching reading." A more general comment was that "it has empowered me to be a well-prepared literacy instructor."

Table 4 . *Teachers Ratings on Applicability of the Course Competencies to Classroom Instruction: Descriptive Statistics and Percentages by Response Category*

Course Competency	*n*	Mean	Standard Deviation	Not at all 1	2	Somewhat 3	4	Very Well 5
1. Theories, models, research	12	4.50	.90	0	0	25.0	0	75.0
2. Reading taught as a process	12	5.00	.00	0	0	0	0	100
3. Cultural and diversity issues	12	4.67	.78	0	0	16.7	0	83.3
4. Phonemic, morphemic, syntactic, and pragmatic systems	12	4.92	.29	0	0	0	8.3	91.7
5. Emergent literacy, phonemic, and phonological awareness	12	5.00	.00	0	0	0	0	100
6. Research and psychology in literacy and reading	12	4.50	.90	0	0	25.0	0	75.0
7. Literacy as a learning tool across the Curriculum	12	5.00	.00	0	0	0	0	100
8. Strategies for including parents as partners in literacy dev.	12	4.17	1.34	8.3	0	25.0	0	66.7
9. Vocabulary strategies for comprehension and Development	12	5.00	.00	0	0	0	0	100
10. Questioning strategies and techniques	12	5.00	.00	0	0	0	0	100
11. Collegial group work for decision making and support	11	4.82	.60	0	0	9.1	0	90.9
12. Reading, practices, and student responses to literacy strategies	12	4.67	.78	0	0	16.7	0	83.3

Table 5 . *Final Grades for the School Teachers Enrolled in Reading Course*

Final Course Grade	Percentage Range	Number of Students	Percent of Students
A	90 – 100	7	58.33
B	80 – 89	4	33.33
C	70 – 79	1	8.33
Total		12	100

The second open-ended question asked teachers to describe how the course changed the way they teach reading. All ten teacher responses were positive and suggested changes in their teaching as a result of the course. The predominant theme of using various effective strategies to teach reading emerged in responses ("I have learned the application of many strategies and skills"). More specific strategies included the "method framework" aligned with district frameworks and reader response journals that "allowed students to use this opportunity to connect their reading with their writing."

Only four teachers responded when asked for any other comments that would help us to evaluate the course. Two of the responses indicated their appreciation of the instructor who was described as "sensitive," "cooperative," and "great." The other two praised the course more generally. "This has been a great learning experience to help me with reading. I would like to take other reading courses."

The checklist questions asked teachers whether they would be interested in (1) other reading courses; (2) workshops or other professional development opportunities, and (3) reading more professional articles or books related to reading. A high percentage of teachers (73%) said they would be interested in both taking other reading courses and other workshops, and/or other professional opportunities related to reading. A smaller percentage (55%) expressed an interest in reading more professional articles or books related to reading.

Teachers' Performance in the Reading Course

All twelve teachers in the reading course (Survey of Reading Instruction) completed the class, and nearly all performed well in the course. Table 5 shows the final grade distributions for these teachers.

The table 5 shows that the largest percentage (58.33%) of participating teachers obtained between 90% and 100% of the available points and earned an A grade in the course. Another 33% scored between 80% and 89% and earned a B. Only one teacher candidate earned lower than a B (a C+). These percentages were very similar to the class averages. The average percentage for the class was 89.86% and the average percentage for participating teachers was 89.33%. The distribution of grades was very similar across exams and other assignments (e.g. the literature review).

Fourth and Fifth Grade Teacher Questionnaires

The second questionnaire was administered to all fourth and fifth grade teachers at the end of the school year. The teachers were asked to mail back the questionnaires to the lead evaluator in the return envelope provided. All nine teachers in these grade levels completed and returned the questionnaire.

The questionnaire contained both quantitative rating scale questions and open-ended questions. The rating scale questions corresponded to the topics or strategies covered in the professional development workshops. On the first scale,

Table 6 . *Teachers Ratings on Applicability of the Course Competencies to Classroom Instruction: Descriptive Statistics and Percentages by Response Category*

Course Competency	*n*	Mean	Standard Deviation	Not at all 1	2	Somewhat 3	4	Very Well 5
1. Theories, models, research	12	4.92	.29	0	0	0	8.3	91.7
2. Reading taught as a process	12	5.00	.00	0	0	0	0	100
3. Cultural and diversity issues	11	4.55	.82	0	0	18.2	9.1	72.7
4. Phonemic, morphemic, syntactic, and pragmatic systems	12	5.00	.00	0	0	0	0	100
5. Emergent literacy, phonemic and phonological awareness	12	4.83	.58	0	0	8.3	0	91.7
6. Research and psychology in literacy and reading	12	4.58	.79	0	0	16.7	8.3	75.0
7. Literacy as a learning tool across the curriculum	12	5.00	.00	0	0	0	0	100
8. Strategies for including parents as partners in literacy dev.	12	4.42	.90	0	0	25.0	8.3	66.7
9. Vocabulary strategies for comprehension and development	12	4.83	.39	0	0	0	16.7	83.3
10. Questioning strategies and techniques	12	4.83	.39	0	0	0	16.7	83.3
11. Collegial group work for decision making and support	12	4.92	.29	0	0	0	8.3	91.7
12. Reading, practices, and student responses to literacy strategies	12	4.83	.58	0	0	8.3	0	91.7

teachers were asked to rate the extent to which they mastered the workshop strategies. The scale ranged from "Not at all" (1) to "Very well" (5). The second scale asked teachers to rate the frequency with which they used these course competencies in the classroom. This scale ranged from "Never" (1) to "Frequently"(5). Teachers were instructed to leave the question blank if they had not attended the workshop covering particular strategies or concepts. The first open-ended question addressed how the intervention activities influenced classroom teaching. The second solicited suggestions for other kinds of activities that would be beneficial for improving instruction and student achievement. A copy of the instrument appears in Appendix B.

Mastery Ratings

The descriptive statistics for rating scale items on how well the strategies were mastered appear in Table 6. The items are organized by the general topic of the workshop (i.e. Content Reading, Math, and Technology).

For the workshops that covered content reading, the mean ratings on the thirteen strategies ranged from 3.00 to 4.75. These ratings suggest that, on average, teachers perceived that the strategies were at least "somewhat" mastered. The highest mean ratings were obtained for the following five strategies: PAR (Prepare, Assist and Reflect) lesson framework, Two column note taking, GIST (Generating Interactions between Schema and Text) procedure, Graphic representations (4.75, respectively) and Anticipation guide (4.71). The lowest mean rating of 3.00 was observed for the strategy, PQR2ST+ (Preview, Question, Read, Remember, Scan, Touch-up). Nearly 13% of respondents rated this item as "not at all" mastered.

Another 13% rated the INSERT technique, which is a text coding strategy that uses symbols to self-monitor reading comprehension without taking elaborate notes, as "not at all" mastered (*M*= 3.75). In reference to the items covered in the Math workshops, the mean ratings were a bit lower and ranged from 2.56 to 4.33 across the four strategies. The highest ratings were obtained for the strategy of using pattern blocks to determine functional relationships (*M*= 4.33). Nearly 67% indicated that this strategy was "very well" mastered. The two strategies related to using data for decision-making (SOL and Flanagan scores) showed more variation in ratings. Whereas 38% of teachers indicated that these strategies were "very well" mastered, another 38% rated them as "not at all" mastered. The lowest mean rating (2.65) was obtained for the strategy of using the 100 board for patterns.

The final series of workshops addressed strategies related to application of technology to instructional practices. The mean ratings on these seven questions ranged from 3.00 to 4.67. Internet searches and using existing WebQuests for content received the highest mean ratings of 4.67, respectively. 83% of teachers judged that they had mastered these strategies "very well." Using Microsoft Word to develop "How-to sheets" was rated lower by teachers (*M*= 3.00) with 20% indicating that the strategy was not mastered. Teachers perceived that they had at least "somewhat" mastered the remaining strategies related to technology.

Frequency of Strategy Use Ratings

The second scale required teachers to rate how frequently they used the strategies covered in the workshops. The descriptive statistics for these mean ratings across the three types of workshops are presented in Table 7. The ordinal ranking of means comparing mastery to frequency of use was nearly identical; however, the mean ratings for frequency of use were, in almost all cases, lower. The only exceptions (higher mean ratings) were in cases where the number of respondents differed on the two scales. This pattern of results is not surprising because though teachers felt they

Table 7 . *Teachers Ratings on Frequency of Strategy Use in Classroom: Descriptive Statistics and Percentages by Response Category*

Strategy	*n*	Mean	Standard Deviation	Never 1	2	Sometimes 3	4	Frequently 5
Content Reading								
1.Pre-learning Checks	9	3.89	1.05	0	0	55.6	0	44.4
2.PAR lesson Framework	9	4.33	1.00	0	0	33.3	0	66.7
3.Anticipation guide	8	4.00	1.06	0	0	50.0	0	50.0
4.Two column note-taking	9	4.33	1.00	0	0	33.3	0	66.7
5.Steps in cooperative reading	9	3.44	.88	0	0	77.8	0	22.2
6.Interactive Cloze	9	3.22	.67	0	0	88.9	0	11.1
7.PreP strategy	8	3.50	.93	0	0	75.0	0	25.0
8.INSERT technique	9	3.22	1.20	11.1	0	66.7	0	22.2
9.GIST procedure	9	4.11	1.05	0	0	44.4	0	55.6
10.Previewing WIKA	9	3.89	1.05	0	0	55.6	0	44.4
11.Directed reading/ thinking	9	3.67	1.00	0	0	66.7	0	33.3
12.Graphic representations	9	4.11	1.05	0	0	44.4	0	55.6
13.PQR2ST+	9	3.22	1.20	11.1	0	66.7	0	22.2
Math								
1.Pattern blocks for functional relationships	9	3.44	.88	0	0	77.8	0	22.2
2.100 board for patterns, LCM, GCF	6	3.33	.82	0	0	83.3	0	16.7
3.Data based decisions making with SOL scores	5	4.20	1.09	0	0	40.0	0	60.0
4.Data based decisions making with Flanagan	5	4.20	1.09	0	0	40.0	0	60.0
Technology								
1.Inspiration for brainstorming activities	6	2.00	1.67	66.7	0	16.7	0	16.7
2.Inspiration for prewriting activities	6	2.33	1.63	50.0	0	33.3	0	16.7
3.Word for “how to sheets”	4	3.00	1.63	25.0	0	50.0	0	25.0
4.Using screenshots in Word	5	2.60	1.67	40.0	0	40.0	0	20.0
5.Using Draw Program, in word	5	2.60	1.67	40.0	0	40.0	0	20.0
6.Internet searches	6	4.00	1.09	0	0	50.0	0	50.0
7.Using existing WebQuests for content	6	4.00	1.09	0	0	50.0	0	50.0

had mastered most of the strategies, they may not frequently use them in their classrooms. For strategies covered in the Content Reading workshops the mean ratings ranged from 3.22 to 4.33. Mean ratings that ranged from 3.33 to 4.20 were observed for the strategies covered in the Math workshops. On average, the mean ratings obtained on the strategies related to technology were substantially lower and ranged from 2.00 to 4.00. It should be noted, however, that teachers did not receive the Inspiration software, provided by grant funds, until the end of the academic year.

Open-ended items. Six of the nine teachers responded to the open-ended question that asked teachers to describe how the professional workshops and reading course activities influenced their classroom teaching. Some appreciated the array of strategies that they could apply in their classrooms and their impact on student learning and motivation. For instance "The grant activities have enabled me to incorporate a variety of reading strategies and activities, which has increased classroom participation and comprehension. The students show interest, enthusiasm, and often state the strategy they want to use." Other strategies that the teachers found to be beneficial for their instructional practices included cooperative learning, student generated questions and vocabulary, Inspiration software and other technology, PAR framework in reading, and two-column notes.

Six teachers also responded when asked what other kinds of activities would be beneficial for improving instruction and student achievement. Two of the teachers noted that an instructor modeling the implementation of these strategies in the classroom would be "a great follow-up and reinforcement of the concepts." Two others suggested classroom management or "behavior techniques" that would promote on-task behaviors and minimize disruptions. The final two respondents suggested additional "technology techniques" and strategies for involving parents.

Classroom Observations of Fourth and Fifth Grade Classrooms

The evaluations were conducted during the month of May before SOL testing began. This timing to conduct our observations at the end of the school year was intentionally chosen to increase the likelihood that teachers would have been previously exposed to the course and workshop strategies and would have had a chance to try them out in their classrooms. We observed the fourth and fifth grade classes during the Reading/ Language Arts block in the mornings to further increase the likelihood that targeted strategies would be observed. Although teachers were aware of the timeframe for observations, they were not informed about who would be observed on which dates or times. We conducted a total of 19 observations (10 at the fourth grade level and nine at the fifth grade level). All nine of the fourth and fifth grade teachers were observed between one to three times. The observations were approximately 30 minutes in duration.

The observation form used appears in Appendix C. At the top of the form, observers recorded the teacher’s name, grade level, subject area(s), and start and end times. In the next section, observers provided a general description of classroom instruction and activities. The third part of the questionnaire presented a checklist of all strategies covered in the courses and workshops with space to write open-ended comments about strategy implementation, student reactions, and other contextual information. The final section prompted observers

to provide additional notes and comments, including any conversations with teachers about what was observed. Any course handouts or other documents distributed during the observations were collected.

We observed three targeted reading strategies frequently used by the teachers. The first, observed most often in the fifth grade classrooms, was GIST. For this procedure, students first generated summaries of paragraphs individually or in groups and then wrote summaries on the blackboard. Previewing WIKA (What I Know Already) was another frequently observed strategy, especially in the fourth grade. This strategy involves providing information in columns about what they already know, what they would like to know (questions), answers to these questions, and any remaining questions about the reading. It was obvious from observation that these strategies were commonly implemented in the classroom because the teachers had handouts prepared, and the students were clearly familiar with and largely enthusiastic about the techniques. In some cases, the students retrieved a GIST or WIKA lesson in progress from their desks and automatically returned to these tasks in their learning groups. The third most frequently observed strategy was reading across the curriculum. For example, one reading lesson focused on Fine Arts and History, while another focused on astronomy. The reading text integrated the different subject areas, and the teachers were focusing on particular chapters.

Although we frequently observed the teachers' use of questioning techniques, they did not consistently illustrate higher-order or cognitively challenging types of questioning. For example, we observed a good deal of instructional time devoted to preparing students for the SOL test. In this context the questions tended to address multiple choice items and test-taking strategies. The questions were directed at identifying correct alternatives and ruling out incorrect alternatives. In contrast, more sophisticated kinds of questioning were often associated with the reading strategies already described. Students might be asked to make predictions about what might happen in a story and then to provide an explanation for their predictions. They might also be asked to project an artist's intent and audience reaction from a historical perspective.

Another instructional strategy that had some overlap with the reading strategies already discussed was the use of group work in the classrooms. We observed group work primarily in the context of these other strategies (i.e., Previewing WIKA or GIST). Still, there were a couple of exceptions to this trend that occurred in SOL preparation and grammar lessons. Other strategies observed on only single occasions were the INSERT technique, two-column note taking, DRTA (Directed Reading Thinking Activity), incorporating cultural/diversity issues, and using patterns in Mathematics. Again, we sometimes observed these strategies implemented in conjunction with other targeted strategies. The number of strategies we did not observe is equally noteworthy with the caveat that some of these strategies would be difficult to observe directly. For example, the use of technology software or data to tailor instruction might be used in lesson preparation rather than in the lesson itself. Furthermore, we intentionally conducted most of our observations during the Reading block and observed little Math and no Technology instruction.

Fourth and Fifth Grade Student Reading Achievement

To assess the impact of the activities in the training workshops on student achievement, we focused on any available test scores related to reading at the fourth and fifth grade levels. We analyzed fourth and fifth grade STAR data, fourth grade Benchmark scores in reading, fifth grade Benchmark scores in reading and writing, and the percentage of students who passed the fifth grade SOL English exam. The SOLs are not administered in the fourth grade.

STAR scores. Star reading is an online assessment program developed by Renaissance Learning for students in grades K-12. The program uses a combination of the Cloze method and reading comprehension passages to assess various reading skills. Table 8 shows the average scores of STAR assessment obtained from a computerized diagnostic reading assessment program developed by the Renaissance Learning company. Students respond to "cloze" type or incomplete sentences for which they are presented 3 or 4 options (depending on reading level) and then asked to select the most appropriate word to complete the sentence. The difficulty level of the items is calibrated to the students' responses and becomes more or less difficult depending on the students' reading level.

The assessment program yields grade level equivalent (GLE) and percentile scores. The raw score is converted to a grade level equivalent, which provides a normative referent indicating a grade level and month. A GLE equivalent of 5.3 would indicate that students in the norm group who obtained this score were in the third month of the fifth grade. Percentile ranks also are interpreted with reference to the norm group at the same grade levels. For instance, a percentile rank of 65 indicates that this student outscored 65% of the students in the norm group. The percentile rank for a particular GLE will change as months in the school year increase. On average, a beginning third grader would be expected to score about a 3.0 and would be ranked at about the 50th percentile. If the score does not increase after a number of months, the percentile rank would drop accordingly.

Table 8. *Descriptive Statistics for Pre- and Post-test STAR Scores by Grade Level*

	Pre-test		Post-test	
Grade	Average	Stand. Dev.	Average	Stand. Dev.
4th (*n*= 72)				
GLE	3.66	1.01	3.87	1.23
Percentile	41.13	25.15	30.47	23.93
5th (*n*= 66)				
GLE	4.02	1.39	4.38	1.25
Percentile	30.83	22.56	25.59	18.58

Table 9 shows the results of the STAR assessments for fourth and fifth grade students. To examine the amount of improvement in reading that occurred over the entire school year, we compared scores from the first administration of the test (the pretest given in late September or early October) with scores from the last administration of the test (the post-test given in late May or early June). We only included scores from students who were tested on both of these particular dates (matched pairs). Fourth grade students did not take a writing test. The Wilcoxan signed-rank test was used to determine the statistical significance of change in rankings.

Table 9. *Descriptive Statistics for Pre- and Post-Benchmark Scores by Grade Level*

	Pre-test		Post-test	
Grade	Average	Stand. Dev.	Average	Stand. Dev.
4th				
Reading (*n*= 81)	61.23	21.41	67.35	18.54
5th				
Reading (*n*= 80)	54.82	24.13	54.29	15.36
Writing (*n*= 82)	45.67	15.70	48.84	19.20

At the fourth-grade level, the average GLE score on the pretest was 3.66. The corresponding percentile rank was

41.13. At the time of the post-test, which occurred about eight months later, the average GLE increased to 3.87, and the average percentile rank dropped to 30.47. The changes in both the GLE (Z= -2.041, p< .05) and the percentile ranks (Z= -4.53, p< .01) were statistically significant. This indicates that fourth grade students did not keep pace with similar fourth graders in the normative sample. However, it should be noted that the standard deviations for the percentile ranks were very large, indicating a high amount of variation in scores.

A similar pattern of results was obtained for fifth grade students. Both of the comparisons on GLEs (Z= -3.50, p< .01) and percentile ranks (Z= -2.25, p< .03) were statistically significant. While there was a significant increase in GLE, there was a significant decrease in percentile scores. The average GLE score increased from 4.02 to 4.38, while percentile scores decreased from an average of 30.83 to 25.59. Fifth grade students made progress in terms of GLEs. However, similar to the fourth graders, these students did not keep pace with other fifth graders in the norm group.

Benchmark scores. Benchmark scores were used to gauge fourth grade students' progress in Reading and fifth grade students' progress in Reading and Writing. The Benchmark tests are aligned with and modeled after the SOL tests. They are developed by the state of Virginia to provide early diagnostic information and practice for the SOLs. We compared the scores obtained after the first nine weeks of the school year (late November) with those obtained in the third nine weeks (early April). Although this was a relatively short time span, it was another source of evidence pertaining to student progress in the areas of Reading and Writing.

Table 9 provides the average percentage of points obtained on the reading Benchmark test for fourth graders and on the Reading and Writing benchmark tests for fifth graders. We designated the earlier administration of the tests as the pre-test and the late administration as the post-test. Only students with scores available for both the pre- and post-tests were included in the analysis. There was a significant increase in the average percentage of points obtained when comparing pre- and post-test scores at the fourth-grade level ($t_{(1.80)}$= 2.35, p< .03). Students achieved an average of 61% on the pre-test and an average of 67% on the post-test. In an absolute sense, fourth graders scored well on this test, and their scores are improving.

With respect to the performance of fifth graders on the Benchmark tests, we found virtually no change in reading scores. The mean percentages hovered around 55% on both the pre- and post-tests. Writing scores showed a modest, but non-significant increase. The average pre-test scores were nearly 46%, and the average post-test scores were close to 49%.

Standards of Learning Scores

The SOL data related to reading achievement available at the time this report was for the number of fifth-grade students at each proficiency level on the English test. The fifth-grade writing tests of students were being re-scored and therefore were not yet available. The SOLs are not administered to fourth grade students.

Table 10. *Number and Percentage of Fifth Grade English Scores by Proficiency Level*

Proficiency Level	Number	Percent
1. Pass Advanced	3	3.3
2. Pass Proficient	54	58.7
3. Did Not Pass	35	38.0

Table 10 presents the number and percentage of fifth grade English scores by proficiency level. The majority of the school's fifth grade students passed this SOL subtest at the proficient level with a small percentage passing at the advanced level (3.3%). Thirty-eight percent of these students did not pass the English test.

In terms of comparative data, we contrasted how fifth grade students have scored on the English SOL across three years as shown in Table 11. An examination of the percentages reveals a steady increase in the number of students who passed at the proficient level or above. Although the 2003 passing percentage had not reached the state benchmark of 7%, it is certainly approaching this goal. Slowly but surely, the gap between the state average and the school's percentage is decreasing.

Table 11. *Percentage of Fifth Grade Students Who Passed English SOL Tests Compared to the State Average*

	Year 1		Year 2		Year 3	
	State Avg	School Avg	State Avg	School Avg	State Avg	School Avg
Grade 5 English	72.89	39.56	77.73	49.37	NA	62.0

Discussion and Conclusions

Teachers were generally positive about the content and relevance of the academic curriculum and its effectiveness in preparing them to teach reading. However, we learned that teachers came to professional development workshops with various levels of content understanding. In addition, there were significant differences in their background experiences and expectations from the training program, making it critical to assess teacher understanding of subject matter before deciding on the topics for the training workshops so that the workshop curriculum could be tailored to their exact needs. The first question used to guide the evaluation of the professional development program was, "How well did teachers master the content and the skills covered during the course and in the workshops?" According to the teachers themselves, the content and skills were well mastered as evidenced by the consistently high mean ratings on the questionnaire items related to the mastery of the reading course competencies as well as the strategies and the skills covered during the workshops. In addition, the teachers performed well in the course as indicated by the fact that all but one of the participating teachers earned a grade of either A or B in the course.

The second survey question was, "To what extent were the content and skills covered during the workshops implemented in the fourth and fifth grade level classrooms?" Teachers' self-ratings for the applicability of course competencies and the frequency with which they used the strategies covered in the workshops provide indirect evidence of classroom implementation. Again, consistently high mean ratings were obtained on both scales targeting classroom applicability and the use of competencies and strategies, respectively. More direct evidence about the extent of implementation came from our observations of fourth and fifth grade classrooms. Specifically, we noted that some of the targeted skills and strategies had been implemented in the classroom, and a familiarity with these strategies was suggested by the behavior of teachers and students. While a number of strategies appeared to have been consistently implemented in the classroom, many other strategies covered in the workshop and the course were not observed.

The third and final question was, "How did the fourth and fifth grade students perform on measures related to reading achievement?" The results were mixed, as the students did not perform well on the STAR assessments when compared to the norm group. At both grade levels, we saw a small gain in the grade level equivalents, and although these gains did not keep pace with the progress of the norm group over the course of the school year, most students did show progress

on the benchmark scores. We also saw significant gains in the fourth grade Reading scores and a modest gain in fifth grade Writing scores. The SOL English scores revealed that the largest percentage of fifth grade students passed this subtest in comparison with any other tests. A comparison of the SOL pass rates across multiple years suggests an increasing trend of fifth grade students scoring as proficient in English.

The limitations of this evaluation are worth noting. First, research in the real world of schools often precludes the control of variables to isolate cause-and-effect inferences. In particular, because of the simultaneous implementation of several other programs and interventions within the school, it is impossible to establish a causal link between the activities addressed by the intervention and the academic achievement by the students. Instead, we can only rely on the descriptive, comparative data. Another limitation of this study was that all achievement measures were not administered pre and post at all grade levels. In addition, we may have missed opportunities to observe the teachers' application of the skills and strategies targeted by the interventions. Additional observations throughout the academic year would have improved the likelihood of these strategies being observed. Conducting observations only at the end of the school year, i.e., just prior to the SOL testing may not yield the data that is fully representative of the classroom practices throughout the school year. Finally, our study relied heavily on self-reporting by the teachers. While the teachers themselves are largely responsible for carrying out any educational reforms, and their feedback is crucial, self-reported data may not always be completely honest.

Acknowledgement

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Appendix A

List of competencies covered in the course appears below. The first section asks you to rate how well you mastered each competency as a result of this course. The second section asks you to rate their applicability to your classroom instructional practices.

Simply check the box that best represents your response.

Course Competency	How well mastered?			How applicable to classroom?		
	Not at all	Somewhat	Very well	Not at all	Somewhat	Very well
1. Major theories, models, current research and instructional practices in reading education						
2. Reading taught as a process						
3. Cultural and diversity issues as they relate to the reading process						
4. Phonemic, morphemic, semantic, syntactic, and pragmatic systems of language in reading, writing, spelling						
5. Emergent literacy, phonemic awareness and phonological awareness						
6. Researcher role in education, linguistics, psycholinguistics, sociolinguistics, psychology in literacy, & reading						
7. Literacy as a learning tool across the curriculum						
8. Effective strategies for including parents as partners in the literacy development of their children						
9. Effective strategies for vocabulary comprehension and development						
10. Effective questioning strategies and techniques						
11. Collegial group work for decision-making and support						
12. Readings, practices, and student responses to literacy strategies concerning their impact on learning						

B. How has this course changed the way you think about reading instruction?

C. How has this course changed the way you teach reading?

D. As a result of this, would you be interested in the following? (check all that apply)

- Other reading courses
- Workshops or other professional development opportunities related to reading
- Reading more professional articles or books related to reading

E. Do you have any other comments that would help us evaluate this course?

Appendix B
Teacher Questionnaire

List of strategies addressed in courses and workshops appear below. The first section asks you to rate how well you mastered the strategies as a result of what you learned in the course or in the workshops. The second asks you to rate how frequently you use these strategies in your own classroom. Simply check the box that best represents your response. If you did not attend the class or workshop leave the item blank

Strategies	How well mastered?			How applicable to classroom?		
	Not at all	Somewhat	Very well	Never	Sometimes	Frequently
Workshops in content reading						
1. Pre-learning concept checks						
2. PAR lesson framework						
3. Anticipation Guide						
4. Two column note-taking						
5. Steps in cooperative learning						
6. Interactive Cloze procedures						
7. PreP strategy						
8. INSERT technique						
9. GIST procedure						
10. Previewing WIKA						
11. Directed reading/ thinking activity						
12. Graphic representation						
13. PQR2ST+						
Math Workshops						
1. Using pattern blocks for fractional relationships						
2. Using the 100-Board to show patterns and find LCM and GCF						
3. Data based decision-making using SOL scores						
4. Data based decision making using Flanagan scores						
Technology Workshop Qs						
1. Using Inspiration for brainstorming activities						
2. Using Inspiration for pre-writing activities						
3. Using Word to make “how to sheets”						
4. Making screenshots in Word						
5. Using the Draw program in Word						
6. Conducting internet searches						
7. Examining existing Webquests for usable content						

Open-ended items (use back of page if necessary)

1. How have the activities influenced your classroom teaching?

2. What other kinds of activities would be beneficial for improving your instruction and student achievement?

Appendix C
Teacher Questionnaire

List of strategies addressed in courses and workshops appear below. The first section asks you to rate how well you mastered the strategies as a result of what you learned in the course or in the workshops. The second asks you to rate how frequently you use these strategies in your own classroom. Simply check the box that best represents your response. If you did not attend the class or workshop leave the item blank.

Strategies	How well mastered?			How applicable to classroom?		
	Not at all	Somewhat	Very well	Never	Sometimes	Frequently
Workshops in Content Reading						
1. Pre-learning concept checks						
2. PAR lesson framework						
3. Anticipation Guide						
4. Two column note-taking						
5. Steps in cooperative learning						
6. Interactive Cloze procedures						
7. PreP strategy						
8. INSERT technique						
9. GIST procedure						
10. Previewing WIKA						
11. Directed reading/ thinking activity						
12. Graphic representation						
13. PQR2ST+						
Math Workshops						
1. Using pattern blocks for fractional relationships						
2. Using the 100-Board to show patterns and find LCM and GCF						
3. Data based decision-making using SOL scores						
4. Data based decision making using Flanagan scores						
Technology Workshop Qs						
1. Using Inspiration for brainstorming activities						
2. Using Inspiration for pre-writing activities						
3. Using Word to make “how to sheets”						
4. Making screenshots in Word						
5. Using the Draw program in Word						
6. Conducting internet searches						
7. Examining existing Webquests for usable content						

Open-ended items (use back of page if necessary)

1. How have the Beazley grant activities influenced your classroom teaching?

2. What other kinds of activities would be beneficial for improving your instruction and student achievement?

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More Evidence that Math Anxiety is Specific to Math in Young Children: The Correlates of the Math Anxiety Questionnaire for Children (MAQC)

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Abstract

Although interest in math anxiety in young children has recently increased, the results of previous studies on math anxiety correlates are inconsistent. The article presents the results of two studies conducted among early school-age learners (6–11 years) where the Math Anxiety Questionnaire for Children (MAQC) was used. The results indicate that the MAQC score (a) positively and moderately/strongly correlates with math anxiety scores obtained with other scales, (b) positively and mainly moderately correlates with general and test anxiety, (c) and negatively and weakly/moderately correlates with math achievement. Negative, weak, and significant relationships between math anxiety and math achievement occur even if general and test anxiety are controlled. Moreover, the results of the group comparison test show that children with a high level of math self-esteem have lower math anxiety than children with medium math self-esteem and this effect is large. Children with medium and high Polish language self-esteem do not differ from each other in math anxiety. It may be concluded that math anxiety in young children is a specific kind of anxiety, and its correlates are similar to those in secondary school-age children, adolescents, and adults.

Keywords: Math Anxiety, Math Achievement, General Anxiety, Test Anxiety, Early School-Age Children

Math Anxiety in Early School-Age Children

Math anxiety is "a feeling of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972, p. 551). Math anxiety is defined as a specific kind of anxiety that negatively affects math outcomes on various levels of math education (Hembree, 1990). Research conducted among increasingly younger students has led to the discovery that even children starting school feel some level of math anxiety (Carey, Hill, Devine, & Szűcs, 2017; Cargnelutti, Tomasetto, & Passolunghi, 2017; Ganley & McGraw, 2016; Gierl & Bisanz, 1995; Harari, Vukovic, & Bailey, 2013; Hill, Mammarella, Devine, Caviola Passolunghi, & Szűcs, 2016; Jameson, 2013, 2014; Krinzinger, Kaufmann, & Willmes, 2009; Mutlu, 2019; Ramirez, Gunderson, Levine, & Beilock, 2013; Ramirez, Chang, Maloney, Levine, & Beilock, 2016; Vukovic, Kieffer, Bailey, & Harari, 2013; Young, Wu, & Menon, 2012; Wu, Barth, Amin, Malcarne, & Menon, 2012). Although the number of studies on the nature of math anxiety in children has increased, some theoretical issues related to its characteristics remain unclear.

There is insufficient evidence that math anxiety in young children is a specific kind of anxiety. Previous studies on math anxiety specificity mostly test the shared variance of math anxiety with general anxiety defined as an individual's disposition toward worrying about a number of different things, events, behaviors, and competences (Spence, 1997), and with test anxiety defined as an apprehension in situations involving performance evaluation (Putwain & Daniels, 2010). Some of the studies in young children showed that math anxiety moderately or strongly correlates with general anxiety (Carey et al., 2017; Cargnelutti et al., 2017; Ganley & McGraw, 2016; Hill at al., 2016; Szczygieł, 2019) and with test anxiety (Carey et al., 2017; Gierl & Bisanz, 1995). However, other studies reported no such relationship between math anxiety and general anxiety (Cargnelutti et al., 2017; Gierl & Bisanz, 1995; Wu et al., 2012). Assuming that a significant proportion of math anxiety variance is shared with general and test anxiety, then math anxiety is rather an unspecific manifestation of general or test anxiety. If math anxiety and general and test anxiety are weakly or moderately correlated with each other, this could suggest that math anxiety is a unique construct (Carey et al., 2017; Stöber & Perkur, 2004).

Furthermore, if math anxiety is a specific type of anxiety, then the scores of various math anxiety scales should be highly correlated with each other and such a relationship should be stronger than the relationship between math anxiety and general and test anxiety. Usually, correlations between various math anxiety measures and both general anxiety and test anxiety are tested; however, the specificity of math anxiety should also be confirmed in other ways. If math anxiety is specific to mathematics, its level should be dependent on math self-esteem (Eden, Heine, & Jacobs, 2013; Ganley & McGraw, 2016) rather than language self-esteem, for example. Therefore, children who are good at math should have high math self-esteem and low math anxiety, and their counterparts who are bad at math may have low math self-esteem and a high level of math anxiety (Eden et al., 2013; Szczygieł, 2019). That said, language self-esteem should not affect the level of math anxiety. If the level of math anxiety and the level of self-esteem in academic domains other than math are related to each other, this means that math anxiety is more general than it may be supposed.

Based on previous studies, it can be assumed that math anxiety should be negatively related to math achievement. Most studies involving young children showed a negative correlation between math anxiety and math achievement (Gierl & Bisanz, 1995; Harari et al., 2013; Jameson 2013; Ramirez et al., 2013, 2016; Wu et al., 2012; Vukovic et al., 2013 – among children with high working memory capacity; Szczygieł, 2019); however, other studies reported no relationship between both variables (Cargnelutti et al., 2016; Krinzinger et al., 2009; Harari et al., 2013; Thomas & Dowker, 2000). The inconsistent results may be down to the varying validity and reliability of math anxiety measures and the type of mathematical tasks (Cargnelutti et al., 2016; Harari et al., 2013; Krinzinger et al., 2009; Thomas & Dowker, 2000). Therefore, it can be assumed that if the appropriate measure of math

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anxiety is used, the relationship between math anxiety and math achievement should occur in early school-age children. Moreover, if math anxiety is specific to mathematics, it should be correlated with math achievement – even if general and test anxiety are controlled. However, there is little research that tests these relationships. Some studies show that math anxiety and math achievement are related when general (Ganley & McGraw, 2016; Hill et al., 2013 – in secondary children) and test anxiety (Gierl & Bisanz, 1995; Van Mier, Schleepen, & Van den Berg, 2019 – in girls) are controlled, but others indicate no such relationship (Ganley & McGraw, 2016; Hill et al., 2013 – in primary children; Van Mier et al., 2019 – in boys). At the same time, previous studies do not test the relationship between math anxiety and math achievement when general and test anxiety were controlled. Therefore, if math anxiety is related to math achievement in young children, even in those cases where general and test anxiety are controlled, this means that math anxiety is uniquely related to math.

Finally, most of the studies on math anxiety in children, adolescents, and adults are conducted among English language samples. However, due to international differences in the organizational system of mathematical education, it is justified to follow the data obtained from cultural backgrounds other than the West (Browne, Ortiz-Padilla, & Soto-Varela, 2020). If subsequent studies provide further arguments on the specificity of math anxiety and its detrimental effect on math achievement in young children, more attention should be paid to the identification of its sources and the prevention of future math anxiety development.

Present Study

Since the results of previous studies on the specificity of math anxiety are inconsistent or insufficient, the main purpose of this article is to provide additional data on the nature of math anxiety in young children. In the paper, the results of two studies are presented which were conducted in a sample of Polish first- to third-grade children. It was assumed that if math anxiety is a specific kind of anxiety, the math anxiety measure (MAQC) should be positively and highly correlated with other measures of math anxiety, and positively and moderately correlated with general and test anxiety. Moreover, math anxiety should be negatively related to math achievement even if general and test anxiety are controlled. Furthermore, children with high math self-esteem in comparison to those with low math self-esteem should be less math-anxious; however, no differences in math anxiety should be observed between children with a low and high level of Polish language self-esteem.

Method

Participants

The results of two studies in early school-age children are presented. The children that participated in the project attended public primary schools in Krakow (Poland). In the first phase of the school's enrollment for the study, schools were randomly selected for examination from the list of all schools in the city. However, the participation of children in it depended on the decision of the head of school, parents, and the children themselves. Some headmasters and parents did not respond to the request or did not give permission for the research.

The first study was conducted in nine schools at the end of the first, second, and third grade in a cross-sectional plan (Study 1). The schools occupied different positions in the ranking of schools in the city from the top to the bottom of the list. The research was conducted in a group of 241 pupils: 46 children (23 girls) from the first grade (mean age 7 years and 3 months, range 6.1–8.3 years), 101 children (60 girls) from the second grade (mean age 8 years and 2 months, range 7.1–9.3 years), and 94 children (51 girls) from the third grade (mean age 9 years and 4 months, range 8.0–11.2 years). The data about education, income, and occupation were collected during a parent-teacher conference. The socioeconomic status of most children's families was moderate or high.

The second study was conducted in twelve primary schools (other than those in the first study). The schools occupied different positions in the ranking of schools in the city (from the top to the bottom of the scale). The study is longitudinal and started at the beginning of the first grade and continues up to today (Study 2). However, the study presents the results collected at the end of the second grade because the MAQC scale was used then. Two hundred and thirty-one second-grade children (110 girls) took part in the measurement. The mean age of children at the end of the second grade was around 8–9 years. The socioeconomic status of the families was assessed based on education, income, and occupation. Most of the children came from families with a medium or high socioeconomic status.

Measures

Math anxiety

The Math Anxiety Questionnaire for Children (MAQC) was developed for measuring general math anxiety in young children. The scale is based on the Mathematics Anxiety Scale in Young Children (MASYC; Harari et al., 2013) and the Scale for Early Mathematics Anxiety (SEMA; Wu et al., 2012). The MASYC is three-dimensional (negative reactions, numerical confidence, and worry), whilst the SEMA consists of two factors (numerical processing anxiety, situational and performance anxiety). First, it was checked whether these scales could be adapted to the Polish early school education environment. Both scales were translated into Polish, back-translated, proofread, and tested in pilot sessions. Following a pilot research that used both scales in a Polish group of early school-age children, a significant number of changes were needed to be made to the MASYC and the SEMA. Firstly, the items were not adequate for the level of the children's language skills (especially that which was related to physiological anxiety). Secondly, the mathematics curriculum in Poland differs from the US curriculum, so math-related questions were not valid and were removed. Finally, the response scale used in the MASYC and the SEMA (a four- or five-point scale) was too complex for children from first to third grade.

The significant modifications made to the MASYC and the SEMA required a new scale to be actually created. Based on the problems described above, the items' reliability, and item content analyses, selected questions from both scales were used in the final version of the measurement. These items concerned math anxiety related to performing math activities, and the final version of the scale was intended to measure general math anxiety related to performing math activities. To improve the validity and reliability of measurement, some new items were added to the scale. The MAQC content follows the definition of math anxiety by Richardson and Suinn (1972). They described math anxiety as a type of anxiety that concerns solving math problems in various academic situations. The final version of the scale consisted of twelve items (see details in Appendix). The response scale was limited to a three-point scale (0 – no, 1 – a little, 2 – yes), which in turn enabled simple answers from children. The higher the MAQC score was, the higher level of math anxiety related to performing math activity was indicated. To eliminate the impact of the children's varying reading skills, the instructions were read aloud by the researcher.

The structure of the scale was tested by exploratory (EFA) and confirmatory (CFA) factor analyses using the combined data from the cross-sectional and longitudinal studies. The data set was divided into two parts that were equal in terms of the type

Table 1. *EFA and CFA in the MAQC*

	n= 368	Sample A	*n*= 184	Sample B	*n*= 184
	M (SD)	Item-scale correlations	*β* EFA	Item-scale correlations	*β* CFA
1	.39 (.66)	.48	.52	.54	.56
2	.67 (.79)	.63	.61	.64	.74
3	.41 (.70)	.58	.61	.49	.55
4	.53 (.73)	.64	.70	.62	.66
5	.72 (.82)	.65	.67	.54	.52
6	.09 (.35)	.56	.82	.46	.80
7	.25 (.55)	.52	.59	.48	.55
8	.16 (.45)	.28	.41	.36	.37
9	.54 (.72)	.57	.57	.56	.55
10	.52 (.73)	.61	.61	.55	.60
11	.12 (.40)	.51	.74	.48	.65
12	.30 (.59)	.55	.58	.47	.47
Model Summary					
Recommended value (Hu & Bentler, 2009)			Obtained value		Obtained value
CFI	> .90				.95
TLI	> .95		.70		.93
SRMR	< 0.08		.09		.13
RMSEA [90% CI]	< 0.06		.15 [.14, .17]		.07 [.04, .09]

Note: All item-scale correlations and the regression path were significant on $p < .001$. CFI – Comparative Fit Index, TLI – Tucker-Lewis Index, SRMR – Standardized Root Mean Square Residual, RMSEA – Root Mean Square Error of Approximation.

of study, grade year, and gender (n_1= 184, n_2= 184). The analyses were conducted in R packages: psych (EFA, Rewelle, 2019) and lavaan (CFA, Rosseel, 2012).

In the first step of the EFA, a parallel analysis was run to extract the actual number of dimensions. Based on the parallel analysis scree plot and item content, one factor was extracted. Then, the principal axis method with the oblimin rotation was applied. Analysis was run on the polychoric correlation matrix because of the ordinal variables. All statistical assumptions were met to conduct EFA: Bartlett's test of sphericity $\chi^2_{(66)}$= 747.76; $p < .001$; KMO= .82; matrix determinant= .08. The extracted factor explained 39% of variance, which is a comparable result to the SEMA (38.29% explained by two factors, Wu et al., 2012) and the MASYC (41.34% explained by three factors, Harari et al., 2013). The model fit indices are below cut-off (especially TLI and RMSEA); however, the item-factor loadings ranged .24–.58, which is acceptable in social sciences (Costello & Osborne, 2005). Moreover, the item-scale correlations varied from r= .28 to r= .63, $p < .001$, which indicates that the items are associated with the overall results in the same direction and at similar levels (see Table 1).

To verify the fit of the unidimensional solution, CFA was performed in the second sample. Mardia's test shows that the assumption of multivariate normality was violated (skewness 2197.02, $p < .001$, kurtosis 29.22, $p < .001$). Because of this and because of the ordinal characteristic of the variables, the Diagonally Weighted Least Squares estimator (DWLS) on the polychoric correlation matrix was used (Mîndrilă, 2010). The model does not fit the data very well ($\chi^2_{(54)}$= 96.44; $p < .001$), but the model fit indices are acceptable (see Table 1). The value of the CFI indicates a good model fit, the TLI and the RMSEA values are on the border of cut-off and indicate a reasonably good model fit, but the SRMS is unsatisfactory. This relatively higher value may be, however, explained by the sample size. The standardized difference between the observed correlation and the predicted correlation is greater for a small number of observations (Nye & Drasgow, 2011). Although the model fit is not perfect, the factor loadings ranged .37–.80, and these values are proper (Costello & Osborne, 2005). Additionally, the item-scale correlations confirm that the scale is consistent (r= .36–.64).

The internal consistency of the MAQC calculated for the whole group is α= 0.77 (n= 368), and the test-retest reliability is r= .56, $p < .001$, n= 55. Therefore, the reliability of the MAQC is very satisfactory.

The modified Abbreviated Math Anxiety Scale for Elementary School Children (mAMAS-E, Szczygieł, 2019) is based on the mAMAS (Carey et al., 2017) and is intended for early school-age children. The scale consists of two subscales: learning and testing math anxiety and has nine items and a three-point response scale. The higher the mAMAS-E scores were, the higher the levels of math anxiety (general, learning, and testing) were indicated. To check the structure of the scale in the tested sample, CFA was applied. Mardia's test shows that the assumption of multivariate normality was violated (skewness 3238.46, $p < .001$, kurtosis 61.18, $p < .001$, n= 419). Additionally, the variables are three-categorical. Therefore, the DWLS estimator was applied and analysis was conducted on the polychoric correlation matrix (Mîndrilă, 2010). The model fits the data very well: $\chi^2_{(26)}$= 36.62; p= .08, and the model fit indices are very satisfactory: CFI= .99, TLI= .99, RMSEA= .03 [90% CI 0, .05], SRMR= .07. The factor loadings ranged .59–.79 (math learning anxiety) and .55–.73 (math testing anxiety); they are both very well (Costello & Osborne, 2005). The internal consistency reliability of the math learning anxiety scale is α= .59, and of the math testing anxiety scale is .71. Stratified alpha calculated for mAMAS-E total is .78. The reliability of the total and the math testing anxiety scores is plausible; however, the internal consistency of the math learning anxiety scale is below expected. The relatively low reliability may be explained by the shortness of the scale and the low variance of the results obtained in a small number of categories in the response scale.

General Anxiety

The Revised Children's Manifest Anxiety Scale (RCMAS, Reynolds & Richmond, 1978) measures general anxiety and consists of a lies scale and three subscales: physiological anxiety

(RCMAS-P), worry/oversensitivity (RCMAS-W), and social concerns/concentrations (RCMAS-S). The Polish language version of the scale was prepared in accordance with the back-translation procedure and tested in other studies. The scale has 37 items, to which the children answer yes/no. The higher score in the RCMAS was, the higher level of anxiety was indicated. The internal consistency reliability of the RCMAS is α= .69 for physiological anxiety, α= .69 for worry, and α= .75 for social anxiety (n= 57). Stratified Cronbach's α for total score is .89. The reliability of the scales is acceptable. The small number of collected observations does not allow for the confirmation of the scale structure in the study.

The Short Revised Children's Manifest Anxiety Scale (sRCMAS, Stark & Laurent, 2001) measures general anxiety. Stark & Laurent (2001) extracted seven items from the RCMAS; they identified them as unique measures of anxiety (irrespective of depression). The scale was prepared in accordance with the back-translation procedure, improved in the Polish language, and adapted to the Polish environment. The response scale on which children assessed the level of their anxiety consists of three categories (0 – no, 1 – a little, 2 – yes). The higher the sRCMAS score was, the higher level of general anxiety was indicated. Based on the authors' remarks and items' content, the scale was assumed to be unidimensional. To check the structure of the scale, CFA was conducted (n= 203). Because Mardia's test reveals multivariate nonnormality (skewness 186.55, p< .001, kurtosis 2.11, p< .05) and the response scale is ordinal, the analysis was conducted with the DWLS estimator and the polychoric correlation matrix (Mîndrilă, 2010). The model significantly deviates from the data ($\chi^2_{(26)}$= 186.69; p< .001), and the model fit indices are on the border of acceptance: CFI= .88, TLI= .83, RMSEA= .06 [90% CI .05, .08], SRMR= .12. Although the model fit is not excellent, the factor loadings in the model vary from .40 to .74 and are acceptable (Costello & Osborne, 2005). The internal consistency of the scale is also plausible: α= .70.

Test Anxiety

Test anxiety in the children was measured by the Children's Test Anxiety Scale (CTAS, Wren & Benson, 2004). The CTAS has 30 items and three subscales: thoughts, off-task behaviors, and autonomic reactions; however, in the present study, only the thoughts subscale (CTAS-T; consisting of 13 items) was used. The CTAS-T was translated into Polish, back-translated, and subsequently improved. The scale is a four-point measurement tool: children described their feelings when taking a test from 1 (almost never) to 4 (almost always). As the number of points in the test increases, the level of test anxiety grows. The structure of the CTAS-T was checked using CFA (n= 249). Mardia's test indicates multivariate nonnormality (skewness 1241.90, p< .001, kurtosis 18.55, p< .001), and the variables are ordinal; therefore, the DWLS estimator and the analysis on the polychoric correlation matrix were run (Mîndrilă, 2010). Although the model significantly deviates from the data ($\chi^2_{(26)}$= 128.69; p< .001), the model fit indices are very satisfactory: CFI= .98, TLI= .99, RMSEA= .06 [90% CI .05, .08], SRMR= .08. The factor loadings ranged .38–.80 and are proper (Costello & Osborne, 2005). The internal consistency reliability of the CTAS-T is appropriate: α= .86.

Math and Polish Language Self-esteem

In order to divide children into groups, they were asked questions about their Math (MSE) and Polish (PSE) self-esteem. Children were asked the following questions: "Are you good at Math? Yes, a little, or no?" and "Are you good at Polish? Yes, a little, or no?". Children who answered "yes", "a little", and "no" were assigned to the group "high self-esteem", "moderate self-esteem", and "low-self-esteem,", respectively.

Math Achievement

Because no standardized math knowledge tests for early school-age children were available in Poland, the tasks of my own design were used to measure math achievement (MATH) in both studies. I prepared the tasks in cooperation with a mathematician. The main objective of the test construction was to prepare the representative sample of mathematical tasks in accordance with the core curriculum for elementary schools and educational materials recommended by the Polish Ministry of Education. No dimensions of the constructed tasks were assumed.

The preparation of the tasks in the cross-sectional study was as follows. Initially, twenty tasks were prepared for each grade year, and each task consisted of several examples. The properties of item-content and the instructions were rated by a team consisting of several psychologists, an early education teacher, and a mathematician. After improving the test, two pilot sessions were conducted in individual meetings with twenty-one children. The pilot studies allowed me to determine the level at which children understood the instructions, improve the way with which children's answers were rated, and ascertain the level of difficulty in the tasks and their approximate solving time. Finally, eleven complex and representative tasks were selected for the final version of the test. The mathematical test preparation procedure in the longitudinal study was analogous to the one used in the cross-sectional study. Most of the tasks from the first study were reused; however, more examples were added to improve the validity and reliability of the children's math skills assessment.

MATH-1, MATH-2, and MATH-3 were used in the cross-sectional study, MATH-II in the longitudinal research. The following mathematical areas were measured in the first- to third-grade children: MATH-1 - knowledge of numbers, counting, addition, and subtraction, discovering rules, knowledge of money, knowledge of geometric figures, and reading a tape measure; MATH-2/MATH-II - addition and subtraction, multiplication and division, reading a tape measure, spatial orientation, discovering rules, and clock reading; MATH-3 - addition and subtraction, multiplication and division, reading a tape measure, discovering rules, clock reading, and knowledge of dates and money.

In both studies, mathematical tasks were performed by the children themselves, but instructions were read aloud by the researcher to eliminate the impact of the children's varying reading skills. The children completed the mathematical test in 20–40 minutes. In the cross-sectional study, the children could score a maximum of 36 points, and in the longitudinal study 62.

The psychometric properties of the tests were ascertained. All correlations between mathematical tasks and whole scores in math tests are weak/moderate/strong, positive, and significant (p< .01): MATH-1 r= .39–.69, MATH-2 r= .29–.71, MATH-3 r= .32–.74, MATH-II r= .29–.61. The scale consistency was also confirmed by the satisfactory reliability of the math achievement tasks: MATH-1 α= .80, MATH-2 α= .83, MATH-3 α= .89, MATH-II α= .91. Additionally, the level of difficulty for mathematical tasks in each grade year was calculated by the ratio of points actually scored by all children to the maximum number of points that could be obtained. The average level of difficulty for math tasks in study 1 is .77, .71, and .71 for first, second, and third grade, respectively, and .69 in study 2. In accordance with the assessment of Janowicz (2017), the tasks can be referred to as "easy" or "moderately difficult".

Procedure

Both studies were conducted in public schools in Krakow after ethical permission had been obtained from the Scientific Research Ethic Committee of the Institute of Psychology, Jagiello-

nian University of Krakow and approval given from the head of each school and children's parents. The cross-sectional study consisted of two meetings at the end of the school year. The first test session was in April–May 2017, and children were checked in general anxiety (RCMAS), math anxiety (MAQC, mAMAS-E), and math self-esteem (MSE). The second test session was conducted in May–June 2017, and children were tested in math performance (MATH-1, MATH-2, and MATH-3). Children from the longitudinal study were tested at the end of second grade in May and June 2019. They were surveyed in math anxiety (MACQ, mAMAS-E), general anxiety (sRCMAS), test anxiety (CTAS-T), math self-esteem (MSE), Polish language self-esteem (PSE), and math achievement (MATH-II).

Children were surveyed in individual meetings with a research assistant. Each time, children were informed about the purpose of the study, the possibility to refuse to answer questions, and the possibility to withdraw from the study at any time. To eliminate the influence of children's reading skills on the level of their instruction comprehension, all instructions were read aloud by the researcher. Answers about general anxiety, test anxiety, math anxiety, and math and Polish self-esteem were written down by the researcher on the answer card, while solutions to mathematical problems were written on the cards by the children themselves. The average time of the test session lasted 20-45 minutes.

Results

The analyses were conducted in PS IMAGO PRO 5.1. The results obtained in the two studies are presented together because the collected data are complementary and based on the same tasks and the same age group. The effect size of group comparison was calculated by the calculator of Lenhard & Lenhard (2016).

Firstly, the descriptive statistics of the MAQC were calculated. The MAQC distribution is right-skewed and deviates from normality (skewness= 1.23, kurtosis= 1.56, W= .89, p< .001). The mean MAQC score is low (M= .39, SD= .34); however, both those who feel no math anxiety or are very math-anxious (range 0–1.83) could be found in the sample. The mean score of math anxiety in girls (M= .44, SD= .38, n= 193) is higher than in boys (M= .31, SD= .34, n= 176) and this gap is small/medium ($t_{(367)}$= -2.80; p< .01; d= .36).

In the second step of the analysis, the specificity of math anxiety was checked by a series of Pearson's correlation tests. It was tested whether the math anxiety measured by the MAQC is related to another measure of math anxiety, general anxiety, test anxiety, and math achievement (see Table 2).

The results from both studies show that the math anxiety measured by the MAQC positively and moderately/strongly correlates with total, math learning, and math testing anxiety. The MAQC score positively and mainly moderately correlates with general anxiety and moderately with test anxiety. Negative and weak/moderate relationships were observed between the MAQC score and math achievement. The results are mostly consistent with those formulated in the assumptions (see: introduction).

Afterward, additional analyses were conducted to check whether the MAQC score is related to math achievement even when general anxiety and test anxiety are controlled (see Table 3).

In study 1, it was tested whether the MAQC score is related to the MATH score calculated together for children from first to third grade. The combination of data was justified because of: (a) relatively few observations in each grade year; (b) non-significant differences in the average result in MATH in each grade year; and (c) almost the same difficulty level of mathematical tasks in each grade year. The results indicate a significant, negative, and moderate correlation between math anxiety and math achievement when general anxie-

Table 2. *Zero-order Correlations with the MAQC Score*

	Study	Task	*N*	Mean (*SD*)	MAQC	Effect size interpretation
Math anxiety	1&2	mAMAS-E Total	284	.34(.34)	.66***	Strong
		mAMAS-E Learning	284	.18(.29)	.59***	Moderate/Strong
		mAMAS-E Testing	284	.53(52)	.56***	Moderate
General anxiety	1	RCMAS	57	.40(23)	.60***	Moderate/Strong
		RCMAS-P	57	.37(24)	.48***	Moderate
		RCMAS-W	57	.36(26)	.57***	Moderate
		RCMAS-S	57	.33(30)	.49***	Moderate
	2	sRCMAS	119	.68(.48)	.47***	Moderate
Test anxiety	2	CTAS-T	127	2.03(.61)	.47***	Moderate
Math achievement	1	MATH-1	46	27.75(4.98)	-.40**	Weak/Moderate
		MATH-2	101	25.91(6.06)	-.39***	Weak/Moderate
		MATH-3	93	25.67(7.33)	-.37***	Weak/Moderate
	2	MATH-II	127	42.83(9.88)	-.38***	Weak/Moderate

Note: * p< .05; ** p< .01; *** p< .001. The effect size is provided based on Evans' proposal (1996): r< .20 very weak, .20–.39 weak, .40–.59 moderate, .60–.79 strong, > .80 very strong correlation.

Table 3. *Partial Correlations between the MAQC Score and Math Achievement (General Anxiety and Test Anxiety as Covariates)*

Study 1			Study 2		
Controlled by		MAQC	Controlled by		MAQC
RCMAS	MATH 1-3	-.31*	sRCMAS	MATH-II	-.33***
RCMAS-P		-.34*	CTAS-T		-.26**
RCMAS-W		-.35**	sRCMAS & CTAS-T		-.28**
RCMAS-S		-.30*			

Note: *p< .05; **p< .01; ***p< .001; Study 1: n= 55, study 2: n= 116–125. All correlations are weak in accordance to Evans' proposal (1996).

ty is controlled. The type of general anxiety does not change the results. In study 2, it was checked whether math anxiety is related to math achievement when general anxiety and test anxiety are controlled separately and together. The results show a significant, negative, and weak relationship between the MAQC score and math achievement in each case. Therefore, the results from both studies confirm that math anxiety is related to math achievement even when general and test anxiety are controlled.

Finally, it was planned to compare children with low and high levels of math and Polish language self-esteem; however, in the tested sample, there were only a few children with low levels of math self-esteem. Because of that, a comparison between children with moderate and high levels of math and Polish self-esteem was performed. Children with moderate math self-esteem (M= .60, SD= .35, n= 53) feel stronger math anxiety in comparison to those with high levels of math self-esteem (M= .29, SD= .29, n= 67) and the difference is large ($t_{(118)}$= 5.34; p< .001; d= .97). However, a lack of statistically significant differences between children with a moderate (M= .44, SD= .42, n= 46) and high (M= .48, SD= .39, n= 69) level of Polish language self-esteem was noted ($t_{(113)}$= -.65; p= .51; d= .10).

Discussion

Math anxiety is considered an important predictor of mathematical skills in school-age children, adolescents, and adults (Dowker, Sarkar, & Looi, 2016; Zhang, Zhao, & Kong, 2019). In recent years, it was observed that children starting school also display some syndrome of math anxiety (Ganley & McGraw, 2016; Jameson, 2013; Ramirez et al., 2013). Since children in first to third grade do not have many math-related experiences, it prompts questions about the specificity of math anxiety in young children. Can we explain math anxiety by general anxiety or test anxiety? Does math anxiety negatively affect children's math performance? If yes, does the effect occur when general and test anxiety levels are controlled? Since math anxiety in young children has been studied relatively recently, more evidence needs to be gathered for the specificity of math anxiety in this age group. The answer to this gap is two complementary studies conducted among children from first to third grade.

The results of both studies show that math anxiety is specific to mathematics and cannot be identified with general or test anxiety. First of all, it was shown that math anxiety measures are moderately or strongly correlated with each other and such correlations were mostly stronger than the relationships between the MAQC score and general and test anxiety. Although math anxiety shares a substantial part of variance with general and test anxiety, these constructs are not correlated strongly enough with each other to conclude that they are identical.

Secondly, the level of math anxiety was dependent on the level of math self-esteem but not on the level of Polish language self-esteem. It turns out that young children can properly assess their own school subject skills. In this domain, self-esteem is connected to the level of their anxiety toward school subjects. If math anxiety was not specific to mathematics, its level would not only depend on self-assessment of their mathematical skills (Goetz, Cronjaeger, Frenzel, Ludtke, & Hall, 2010; Szczygieł, 2019), but also language skills.

Moreover, research results provide evidence that math anxiety is negatively and moderately related to math achievement in children from first to third grade, which means that such a relationship occurs irrespective of the type of math tasks. Therefore, the obtained results provide more evidence that math anxiety is negatively related to math achievement in young children (Gierl & Bisanz, 1995; Harari, 2013; Jameson, 2013; Ramirez et al., 2013, 2016; Szczygieł, 2019; Vukovic et al., 2013; Wu et al., 2012). Furthermore, the negative relationship between math anxiety and math achievement persists when general anxiety and test anxiety are separately and simultaneously controlled. These results clearly demonstrate that math anxiety in young children is something more than a disposition toward feeling anxiety in everyday or test situations (Ganley & McGraw, 2016; Gierl & Bisanz, 1995; Hill et al., 2013; Van Mier et al., 2019). Therefore, the research results indicate that math anxiety in young children is similar to that in older children, adolescents, and adults, and is a specific kind of anxiety (Ashcraft, 2019; Hembree, 1990; Ma, 1999).

Similar to other research results, the study shows that the average level of math anxiety in the studied group was low, but there were some children with a high level of math anxiety (Carey et al., 2017; Cargnelutti et al., 2017; Ganley & McGraw, 2016; Krinzinger et al., 2009; Ramirez et al., 2016; Wu et al., 2012; Young et al., 2012). The results fit Zhang et al.'s math anxiety development model (2019), which assumes that low levels of math anxiety at the beginning of education increase throughout the years, peak in high school and then slowly decrease, while not disappearing completely in adulthood. Because math anxiety predicts the avoidance of math-related activities (Choe, Jennifer, Rozek, Berman, & Beilock, 2019), it is necessary to know the sources of math anxiety formation and development. Among the factors contributing to children's math anxiety are individual and environmental factors such as genetic factors (Wang et al., 2019) and factors related to teachers and parents (Maloney et al., 2015; Szczygieł, 2020). Indeed, previous studies show that children's math anxiety is underlined by anxieties related to making mistakes, bad grades, dissatisfaction shown by teachers and parents, and ridicule in front of the whole class. However, because of little support for the hypothesis that teaching methods or teachers' and parents' own math anxiety directly or indirectly affects children's math anxiety (Beilock, Gunderson, Ramirez, & Levine, 2010; Maloney, Ramirez, Gunderson, Levine, Beilock, 2015; Soni & Kumari, 2017; Szczygieł, 2020), further research is needed in this area.

Moreover, the present research results show that girls are more math-anxious than boys, which is in accordance with the results obtained in some studies (Carey et al., 2017; Griggs, Rimm-Kaufman, Merritt, & Patton, 2013; Hill et al., 2016; Szczygieł, 2019), but contradictory to other reports (Gierl & Bisanz, 1995; Harari et al., 2013; Jameson, 2014; Kucian et al., 2018; Ramirez et al., 2013; Young et al., 2012). The gender gap in math anxiety was also discussed in studies among secondary school learners and adults. These studies either indicated that females have higher math anxiety levels than males (Núñez-Peña, Suárez-Pellicioni, & Bono, 2016) or demonstrated no differences in math anxiety levels between males and females (Birgin, Baloglu, Catlioglu, & Gurbuz, 2010; Devine, Fawcett, Szűcs, & Dowker, 2012). Both theorists and practitioners may find it vital to determine whether gender differences in math anxiety occur or not in young children. One of the purported reasons for women "escaping" from STEM sciences is math anxiety (Choe et al., 2019). In accordance with the obtained results, math anxiety starts at an early school age and is higher among girls than boys. Therefore, it seems that being female is a risk factor for the development of math anxiety; however, more studies are needed in this area.

Finally, methodological issues should be noted. One of the limitations to these studies is the generalizability of the obtained results on the early school-age children population. Both studies were conducted in children living in a big city and brought up in families with a moderate/high socioeconomic status. The studies involved minors, which means that permission from headmasters and parents was needed to complete them. It is possible that already at the stage of obtaining consent there was a bias in the selection of people interested in participation. Parents interested in their child's education participated in a parents-teacher conference and agreed to have their children examined while less engaged parents refused

consent to the child's participation in the study. This hypothesis is supported by the relatively high socioeconomic status of the children's families and the pupils' high level of math performance. The second important issue concerns the measurement of math, general, and test anxiety, as well as math achievement. Some of the measures used in the study have very well psychometric properties, but others need some improvements and further development. Especially, a greater sample size is needed if the structure of the measurement is tested. Nye and Drasgow (2011) suggest that the CFA model should be run on around 800–1000 observations if the Weighted Least Squares estimator is applied. This is particularly important if correlations between items are weak or moderate (Kenny, 2015). Moreover, Nye and Drasgow (2011) indicate that model fit assessment criteria should be stricter if the DWLS is used instead of the ML estimator. Although the issues of psychological assessment in young children were discussed in detail in other papers (e.g. Ganley & McGraw, 2016; Stark & Laurent, 2001; Szczygieł, 2019), it should be noted that problems with the valid and reliable measurement of emotions in early school-age children are a common phenomenon (Cargnelutti et al., 2016; Harari et al., 2013; Krinzinger et al., 2009; Thomas & Dowker, 2000). To date, over a dozen scales measuring general, test, and math anxiety have been developed; however, researchers are still working to develop a suitable measurement tool for youngest children.

Conclusions

The obtained results show that math anxiety in young children is a specific kind of anxiety. Math anxiety may be partially explained by general and test anxiety; however, this cannot be identified. Math anxiety is related to math achievement and math self-esteem in early school-age children, even if general and test anxiety are controlled together. The study confirms the specificity of math anxiety but leads to the formulation of further questions. Girls exhibit higher math anxiety levels than boys, which raises the question why that is the case. Moreover, although the characteristics of math anxiety in early school-age children are similar to the nature of math anxiety in older children, adolescents, and adults, further studies on math anxiety in young children are needed to establish the sources, development, and mechanism of action of math anxiety on math achievement.

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Appendix
The Math Anxiety Questionnaire for Children (MAQC)

Instruction: I will ask you some questions related to mathematics. Please, answer “yes”, “a little” or “no” to my questions.

1	Do you like solving mathematical problems?	Yes	A little	No
2	Do you like being asked questions during math classes?	Yes	A little	No
3	Do you like to speak about mathematics?	Yes	A little	No
4	Are you nervous when you ask questions about mathematics?	Yes	A little	No
5	Are you nervous at the thought of making a mistake when solving tasks?	Yes	A little	No
6	Are you afraid of mathematics?	Yes	A little	No
7	When you are in math class and the teacher says that you will be discussing a new topic, are you nervous?	Yes	A little	No
8	When you do your homework in mathematics, are you nervous?	Yes	A little	No
9	When you start to solve a difficult task, are you nervous?	Yes	A little	No
10	When you solve a task on the blackboard during math class, do you get stressed?	Yes	A little	No
11	When the teacher explains how to solve a math problem, are you nervous?	Yes	A little	No
12	When you have to ask your teacher for help because you do not know how to solve a task, are you nervous?	Yes	A little	No

Note. Items 1–3 are reversed. Content of items 7, 8, 10, 11, 12 is based on the SEMA, items 1, 2, 5, 6 are inspired by the MASYC, and items 3, 4, 9 are my own proposal. The scale is also available in a 14-item version (author paper).

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Effectiveness of the Direct Instruction Method in Teaching Leisure Skills to Young Individuals with Intellectual Disabilities

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Abstract

This study aimed to examine the effectiveness of the direct instruction method in teaching young individuals with intellectual disability marbling and stone painting, which are considered among leisure-skills. A multiple probe design, one of the single-subject research methods, was utilized in this research. A total of three students, consisting of two males and one female, were included in the study. Probe, screening, and generalization sessions were used to examine the effectiveness of the direct instruction method in teaching marbling and stone-painting skills. The single opportunity method was employed for the assessment. All sessions were conducted in accordance with a one-to-one teaching procedure. The findings of the study revealed that the direct instruction method was effective in teaching marbling and stone painting skills in young individuals with intellectual disabilities. The findings also postulated that the learned skills were maintained at the end of the first, third, and fourth week, and the participants were capable of generalizing the skills to different settings, different people, and materials. To ensure social validity, the opinions of the parents regarding the skills taught to the participants were obtained. They stated that they were satisfied with the intervention and were beneficial for the development of their children. They also expressed that they want these activities to continue. Considering all these findings, it is safe to say that the intervention of teaching marbling and stone-painting skills are effective.

Keywords: Intellectual Disability, Leisure Skills, Marbling, Stone Painting, Direct Instruction Method

Introduction

Leisure time activities are important not only for school-age children and young individuals with special needs but for all individuals in society. These activities have an important place in the lives of individuals and are suitable for using time efficiently. They are also useful for developing social relations and nourishing the soul. Individuals experience a powerful sense of belonging when they participate in these kinds of activities. This kind of activities improve motor skills and social interaction, which deteriorate at later ages, especially in those with intellectual disabilities They promote better health, making one's own decisions, discovering knowledge and resources, and having a more successful transition from education life to adulthood at their earlier ages. Also, leisure activities are an important tool for the rehabilitation of individuals with intellectual disabilities (Patterson, 2007; Stebbins, 2008).

When IwIDs participate in community-based leisure activities, they develop social interaction with their peers without disabilities, consume their excess energy, and they get the opportunity to have a better quality of life. Activities appropriate for their age contribute to their social relations and physical and mental health, and also accelerate their skill development and improve the perception of being a member of the community they live in. Individual differences were focused on less in group activities; therefore, common interests are shared at higher levels in a group. Leisure time is an essential component for family members and educators in social integration. Unfortunately, IwIDs are not aware of this potential throughout their lives and are mainly engaged in home-based activities on their own, being deprived of participating in group activities (Mahon et al., 2000)

.Kaya (2019) classifies leisure activities for IwIDs as follows: leisure/vocational activities: mirrors, door decoration, making felt crafts (as knick-knackery), relief, origami, kirigami, collage (paper crafts), jewelry design, rug weaving, wattling, knitting, magnet making, candle making, soap making, wood painting, and building models of vehicles; Artistic activities: playing an instrument, solo singing, choir, folk dances (music), drawing, drawing people, themed paintings, marbling, ceramic crafts, photography (visual arts, theater, cinema, drama, and dancing (dramatic arts); Physical/sportive activities: hiking, physical training (physical activities), athletics, basketball, riding, cycling, bowling, darts, football, gymnastics, swimming, skating, tennis, volleyball (sports activities); Social and cultural activities: excursions, special days, picnic, cinema, theater, concert, exhibition, shopping; Entertainment/game activities: various games, technological devices (computers, tablets, and game consoles), storytelling hours, cinematography, and paintball.

When IwIDs participate in leisure/vocational activities, they produce a variety of products and spent quality time. Besides, participating in artistic activities will give them an opportunity to obtain an individual identity, increase their self-confidence to express themselves well, provide motor skills, and enhance their hand-eye coordination. Participation in physical/sportive activities keep their healthy, make them socialized, and motivate them with a sense of accomplishment. While social/cultural activities ensure integration and fitting in society, it was found that participation in entertainment/game activities fosters compliant behaviors and treat problematic ones. It appears that through these activities, IwIDs feel more valuable and tolerant. Besides, some studies claimed that social/cultural activities have positive effects on these aspects, such as building a sense of competition, being a part of a team or a group, and self-confidence (Aksu, 2011; Kaya, 2019; Sukan, 2013; Yaman, 2015).

The study of Dusseljee et al, (2011) examining the status of IwIDs participating in leisure activities revealed that these individuals had difficulty in participating in activities compared to individuals without disabilities and were unable to build social interaction. Zilijstra and Vlaskamp (2005) reported that leisure time activities generally include watching television and listening to music and were mainly performed on weekends. The same study also claimed that there were no

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differences between male and female participants. Lövgren and Bertilsdotter-Rosqvist;, (2015) found that leisure time was related to social and physical activities, well-being, and health. The same study revealed that individuals with disabilities participated less in these activities and benefited less from resources. Baker (2000) asserted that the participation of these individuals in leisure activities was limited and noted that they had problems accessing these activities and they mainly performed these activities alone or with their peers.

Chen et al, (2016) reported that the degree of disability affected participation. In a similar study, Rannikko and Torvinen (2018) argued that the lack of sports activities, transportation facilities, and coaching services in Finland restricted the participation of these individuals in leisure activities. However, Badia et al. (2013) could not find a relationship between quality of life and participation in leisure activities, while stating that participation in these activities was a predictor of emotional and physical well-being. Mactavish and Mahon (2005) claimed that IwIDs preferred individual activities that include learning and exercising that they performed with their free will. They added that these activities had a positive effect on their abilities and attitudes and that they were more satisfied with such activities.

In studies examining the participation of children and young IwIDs in leisure time activities, Melbøe and Yttherhus (2017) found that young individuals of both genders mostly preferred sportive and cultural activities and wanted to participate in activities similar to those that their peers without disabilities do.

Buttimer and Tierney (2005) reported that young individuals in special education schools were alone and passive in their leisure activities and their most preferred activities were watching television, listening to music, eating and drinking activities, walking, listening to radio, making phone calls, shopping, reading magazines, family visits, car trips, and watching movies. They added that the obstacles preventing them from participating in leisure time activities included reasons such as lack of sufficient time or money and suitable locations, being unable to travel, being unable to get their parents' consent, and not knowing how the activity is done.

A study by Solish et al. 2010) asserted that there are differences in the participation of children with and without disabilities in social, recreation, and leisure activities. They also claimed that the socioeconomic status of a family affected their participation, and children with autism spectrum disorder participated in these activities more than children with intellectual disabilities. The same study cited the activities they participated as following: playing games, going to birthday parties, spending time with a friend at home, slumber parties, talking on the phone, and going to shopping centers. King et al., (2005) collected data by applying the Children's Assessment of Participation and Enjoyment and Preferences for Activities of Children scales to children with intellectual disabilities in the age group ranging from six to 15. Their findings revealed that there was a correlation between the neighborhood, family and child variables, and entertainment and intensity variables and there were differences between gender and age groups.

The study of King et al. (2014) examined the participation of young individuals with severe disabilities in leisure activities and found that activity setting selected by youngsters provided them with a chance for selection, social interaction, social activity, psychological participation, and a sense of belonging to a group and feeling of self-competence. They also stated that passive activities provided these individuals with the opportunity to challenge, select, and develop social interaction.

Bourke-Taylor et al. (2009) developed and applied a scale titled Assistance to Participate Scale measuring leisure time possibilities of 149 children consisting of different disability groups. The findings of the study revealed that there were differences between the participation of children in inclusive and separate schools and activities done alone at home or school and participation rates of disability groups. The researchers also emphasized that children with intellectual disabilities participated in activities such as watching TV, listening to music, playing indoors and outdoors, playing with friends at home, or their friends' houses. Rosner et al. (2004) reported that there is a correlation between age and social competence in the participation in leisure activities of children with Down syndrome. They also stated that these children did not participate in sports activities and mostly preferred musical activities, reading, and doing puzzles. According to Artar (2018), working young IwIDs, in their leisure time, spent time with home-based passive activities.

Artar and Ergenekon (2019) claimed that leisure time is a timeframe that is neglected in adults with developmental deficiencies and that they encountered problems in participating in these activities. Azaiza et al. (2011) reported that cognitive and physical functions played a role in the participation of adults with intellectual disabilities in these activities and that they had lower participation levels. Corders and Howard (2005) conducted interviews with 60 adults with intellectual disabilities and found that they mainly spent time doing activities such as bowling, swimming, watching television or films, and doing handcrafts. The study of Iriarte et al. (2014) examined 168 adults with intellectual disabilities and determined that the participants considered leisure time activities entertaining, and were happy during the activities. Besides, they mainly participated in leisure activities such as watching television, going to the pub, drinking with friends, listening to the radio, playing the accordion, and going on holiday.

Tamar-Weiss et al. (2003) stated that the participation of young individuals with physical and intellectual disabilities in independent activities was limited. However, they highlighted that the participants could learn these activities with help and independent activities increased their skills and self-esteem; therefore, they were of vital importance. Eratay (2013) examined a group of young individuals with moderate intellectual disabilities and found that more than half of the participants did not play sports or participate in any activities, and they were mainly engaged in playing with computer games, singing, drawing, and doing handcrafts. Moreover, none of them were a member of a club or team.

In a study on the effectiveness of programs regarding leisure time activities, Eratay (2013) found that the prepared program was partially effective in the development of social skills and reducing the emotional-behavioral problems of individuals with intellectual disabilities. Karakaş (2018) reported that the 24-week leisure time activity program improved motor efficiency and physical fitness of children with mild intellectual disabilities while Duvdevang (2002) claimed that participation in recreation programs had a positive effect on the perception of physical self-awareness in children with intellectual disabilities in an inclusive education setting. Açıksöz et al. (2016) argued that therapy gardens should be prepared as an activity for individuals with limited intellectual and physical skills; thus, it will be possible for individuals to integrate into society more effectively. In addition, these individuals' deficiencies in self-esteem would be restored and they could establish mutual relationships with normal people and feel nature. Lancioni et al. (2012) stated that technology-supported programs would be more appropriate for these individuals.

Different methods have been conducted to teach IwIDs leisure skills. Studies on the effectiveness of individualized teaching materials are as follows: button sewing (Demir, 1996), sewing (Özokçu, 1997), and canvas embroidery with tapestry needle (Eratay & Güler Özkan, 2004). Some examples about the effectiveness of simultaneous prompting procedure are as fol-

lows: stockinet stitching (Çankaya & Eratay, 2011), overshoe making (Leblebici, 2012), watching educational CDs on computers (Gökmen, Tekinarslan & Çifçi-Tekinarslan, 2015), foreign language teaching (Çulha, 2010), lawnmowing (Aslan, 2009), stamp collecting (Aslan & Eratay, 2009), photocopying (Yücesoy-Özkan, Gürsel, 2006), painting patterns on wood and fabric (Özbey, 2005), car washing (Topsakal, 2004), playing bowling (Eldeniz-Çetin & Çay, 2016), and rhythm tapping with the guitar (Çay & Özbey, 2016).

Studies on the effectiveness of teaching through video modeling are peeling an orange, drafting stitch, and making origami dogs (Aykut et al., 2014), planting trees (Ulugöl, 2018); cooking pasta (Halisküçük & Çifçi-Tekinarslan, 2007), marbling (Eldeniz-Çetin & Ulugöl, 2017), drawing, listening to music, digital photography (Chan et al. 2013); using iPod (Hammond et al., 2010), washing laundry (Horn et al., 2008), making popcorn (Sigafoos et al., 2005), making coffee (Bidwell & Rehfeldt, 2004), playing basketball, dart air rocket, ball gum, domino, puzzle, and selfie (Cannella-Manole et al., 2016), making bracelets, keyrings, and bookmarkers (Çay & Eldeniz Çetin, 2018). Studies regarding the effectiveness of constant time delay procedure are playing bowling (Zhang et al., 2004) and carpet weaving (Arslan, 2017). Studies regarding the effectiveness of the direct instruction method are playing tablet and computer games (Elçin & Kaya, 2016), doing patchworks (Çay, 2019), and social skill-teaching program prepared in line with a creative drama method (Kaya & Eratay, 2009).

Some studies examined the following teaching leisure skills to children with autism spectrum syndrome: making baskets from clay (Vuran, 2008), teaching basic tennis skills (Yanardağ et al., 2011) regarding the effectiveness of the most to the least prompting; chained task leisure skills (Kurt, 2006), water game skills (Yılmaz et al., 2005), playing card games (Seward et al., 2014) regarding the effectiveness of constant time delay teaching; studies on the effectiveness of teaching with activity schedules (Ünver, 2019; Çuhadar, 2008); studies on the effectiveness of video-model teaching (Blum et al., 2010; Kagohara, 2011); studies on the use of iPod touch (Kagohara et al., 2011; Carlile et al., 2013), basketball, playing with a sticky ball (Altun & Yücesoy-Özkan, 2018).

Individuals with disabilities learned leisure skills through the aforementioned methods. They also maintained and generalized the skills, and these methods were found to be effective.

Kurt and Coşkun (2018) examined the perceptions of families and teachers on the leisure time activities of IwIDs and reported that families of the adults with intellectual disabilities considered the participation of their children in physical activities inadequate, and they believed that their children did not benefit from these activities sufficiently. However, their perceptions revealed that participation in these activities was very important. In a similar study, Eldeniz-Çetin and Terzioğlu (2017) measured the perceptions of mothers with children with severe disabilities in six and 14 age group. They concluded that these children mostly spent time playing alone or with family members, watching TV, and using their tablets.

Bayram (2016) measured the perceptions of mothers of adolescents with and without intellectual disabilities, and participation of these adolescents in leisure activities was compared that both groups mostly watched TV at home. The researcher also found that individuals without intellectual disabilities participated in social activities more, while those with disabilities spent time with small age group activities with low sociality. Another interesting finding of this study is that the participants without intellectual disabilities mostly did activities with their friends, in contrast, their peers with intellectual disabilities participated in these activities with their mothers and people in their close surroundings. Besides, it was stated that while parents wanted their children to do some outdoor activities with their peers, they were worried about their children because of something bad that could happen to their children.

Çay and Eldeniz (2017) found that a systematic study was not conducted on leisure skills in schools that students with intellectual disabilities attended and teachers working in special education schools. They also argued that these students had limited repertoire of these skills, and the skills are needed to be taught to them, and they mostly spent their leisure time with their friends and families. Çay and Eratay (2019) examined the perceptions of the parents of children with multiple disabilities and reported that these children spent most of their time at home, mainly by watching TV, reading books, listening to music, and using mobile phones. They also noted that they exercised and played games with their parents as well as went to the cinema, had dinner, chatted, praying and traveled together.

Eratay et al. (2017) concluded that ceramics education given to children with disabilities in inclusive education resulted in a partial increase in language skills, and families of children with and without disabilities believed that the program was beneficial for their children. They also emphasized that the families demanded new art activities in inclusive education. Although the educators stated that they were involved in this kind of activity for the first time, all children were easily integrated and successful outputs were achieved in both groups.

In the planning of leisure activities; personnel, material, time management, setting, intervention, and assessment are important issues in terms of the functionality of the activity. In Turkey, there are no institutions or organizations having a complete package providing leisure activities systematically. Services and courses provided by public educational centers and local administrations are limited (Kaya, 2019). Identification of the support necessary in teaching leisure activities to individuals with disabilities, preparation of the individual, provision of education with suitable teaching, the inclusion of repetition to teaching, conducting generalization processes were the reason why skill is considered important (Artar & Ergenekon, 2019).

When working with students with intellectual disabilities, the level of students must be first determined and preparation work, such as structured and repeated basic artworks, sensory experience like how to use painting brush on paper, activities on how tools or instruments should be used. Then, processes related to developing motor skills and hand-eye coordination should be conducted, and skill analysis must be performed by dividing the skill into small steps in the teaching of the target art skill (Özdemir, 2018).

Creativity can be expressed in line with daily life, work, family life, social interaction, and especially leisure activities. Creative leisure activities support a positive attitude, develop adaptation, help individuals use spare time appropriately, benefit from some additional spefication and achievement. Furthermore, while they mitigate pain, illness, and anxiety, creative leisure activities improve satisfaction and provide access to the social network. When these activities are provided to an individual, the individual's capacity, adaptation, and assistance to the individual must be taken into consideration. Other things that should be taken into consideration are individual's eye contact, mobility, attention span, and cognitive characteristics. If the individual has difficulty in understanding, a suitable format must be determined by information and structuring. Starting with a short and

simple intervention provides a chance for success that may facilitate focusing on learning. Being a role model may be the right approach. The use of high-quality tools and materials increases the chance of successful output. A suitable distance should be kept with the individual; in addition, the setting and materials must be stimulating If the individual prefers participating in some creative activities with others, his/her access to groups should be facilitated (Creek, 2008).

Marbling art and stone painting are also among the art activities that develop creativity in leisure activities. In marbling art, water concentration is increased with adragant, paint is sprinkled with special brushes, and the patterns on the water are transferred to paper (Arıtan, 1999). Marbling art improves making good use of time, motivation, creativity, patience, and discipline. It also enables stress control, develops self-esteem, motivation, patience, tolerance, understanding, and hand skills. With this activity, children might have peace of mind, develop different perspectives, socialize, and increase their school success (Gür, 2012; Içel, 2014; Kaya, 2012).

In stone art therapy, round stones with smooth surfaces are preferred and painted. The use of different colors is effective in coping with stress. Creative and relaxing activities such as mandala painting, cathartic writing, and drawing help individuals feel better and let them free their minds. With this activity, relaxation, imagination, mental flexibility, improving concentration, and freeing themselves from the burdens of daily problems are attained. Stone art also helps individuals have a great time and improve their artistic skills by opening up an amazing world of possibilities. In stone painting, round stones smoothened by water, acrylic paints, dense acrylic pens, ultra-shiny polishes, and plain brushes are used. Mandalas, animal figures, and entertaining patterns are the most common instruments used in stone-painting designs. Stone art therapy is a preferred intervention and hobby due to its entertaining and economic characteristics (https://sagligabiradim.com/tas-sanati-terapisi-ile-stresi-rahatlatin/ accessed on 26.01.2020).

While stone painting improves children's productivity and aesthetic sense, encountering different materials not only supports their psycho-motor, cognitive, and social developments but also helps develop positive attitudes and behaviors. The stone painting also gives the chance of expressing emotions and thoughts freely, providing an important tool for emotional expression and self-knowledge. Besides, by doing this activity, children develop personality, socialize, and become happy. The most important achievements of stone painting are the development of a sense of aesthetics, creativity, fine motor skills, and hand-eye coordination (https://www.eviminaltintopu.com/tas-boyama-etkinligi/ accessed on 26.01.2020.)

Children and young IwIDs participating in art activities acquire several achievements through these activities. Related studies have shown that simultaneous prompting, activity schedules, constant time delay, and video-modeling are more commonly used methods in teaching leisure skills to IwIDs while teaching with the direct instruction method and teaching of artistic activities is limited. To the best of our knowledge, there is only one study on marbling (Eldeniz-Çetin & Ulugöl, 2017) and no studies were found on stone painting. Besides, studies on playing games on a tablet or computer and patchwork were found regarding the direct instruction method (Elçin & Kaya, 2016; Çay, 2019). It is believed that this study has originality in terms of this aspect. It is considered that the study will not only shed light and contribute to educators and new studies but also provide a new viewpoint for parents and educators.
The study aimed at examining the effectiveness of the direct instruction method in teaching marbling and stone painting as leisure skills to young IwIDs. The study examined the following research questions:

1. Is the direct instruction method for young IwIDs effective for Aycan, Ferit, and Sefa in teaching marbling and stone-painting skills?

2. Are the skills taught with the direct instruction method to young IwIDs maintained after the first, third, and fourth weeks?

3. Are young IwIDs capable of generalizing the skills they learned with different people, settings, and materials?

4. What are the perceptions (social validity findings) of the parents of the participants on skills acquired by the young individuals as a result of the teaching?

Methodology

Study Method

Multiple probe model with an inter-participant probe, one of the single-subject research methods, was used in this study. In this model, the first baseline data were collected simultaneously from all participants. After achieving the stability in the baseline data, the intervention was implemented on the first participant. When the required criterion was met in the intervention, the probe sessions were initiated in all participants, and the data of three consecutive sessions were collected. While the participant who was taught was expected to meet the criteria, the parallelism with baseline data was expected in the two other participants. Following the probe phase, the intervention was conducted on the second participant, and probing was launched on all participants when the criteria were met. While the first and second participants were expected to meet the requirements, the third participant was expected to show parallelism to the baseline data (Tekin-Iftar & Kırcaali-Iftar, 2004). In this study, experimental control was established with the performance shown by the participants at probing phases being similar to the performance of the participants who were taught the skill in the probe phases.

Study Variables

The dependent variable of this study is the level of learning of the marbling and stone-painting skills by young IwIDs. The independent variable is the direct instruction method used in teaching marbling and stone-painting skills to young IwIDs.

Direct Instruction Method

The study adopted the direct instruction method to make students independent in the skill being taught. Before teaching interventions, the content to be taught is organized, and the teaching objectives related to the skill to be taught were determined (Baumann, 1985; Güzel, 1998). Based on clear and written plans, this teacher-centered method is a multi-faceted teaching strategy for assessment (Mitchell, 2008).

The direct instruction method can be used in teaching concepts, processes, or skills to be taught to students. However, students must have prerequisite skills before proceeding to teaching skills (Pearson & Gallagher, 1983).

1) Rosenshine and Stevens (1986) determined the following six stages analyzing the content of the direct instruction process: Daily review stage: The prerequisite skills required for the skill are reviewed and skill teaching is started.

2) Presentation/modeling stage:

-Defining the goals of the skill verbally and in writing (e.g., Today we will do marbling with you)

-Drawing the attention of students and divide the skill into small pieces

-Modeling the skill using a clear and consistent language teacher is showing how to doing the skill by saying "I now take the brush in my hand, dip it into the paint can....")

-Asking questions and making explanations to see whether students understand.

-Providing various examples (We splashed the red paint in the marbling vat first. Now we are splashing the green paint.)

3) Guided practices stage: At this stage, students are expected to adapt to the materials under the guidance and control of their teacher and to achieve 80% success in every step of the skill. Besides, questions can also be asked during this stage. Verbal clues can be given, and when students become independent in the skill, these clues can be held back. Corrective feedback can be provided by the teacher. At the stage of being a model, the student can try out the skill. At this stage, the student performs the skill by doing more exercises while the teacher observes. If the student is unable to perform the skill, the modeling stage is applied (Güzel, 1998; Mitchell, 2008).

4) Correction and feedback stage: Instant feedback is provided to reduce mistakes.

5) Independent Interventions: At this stage, while students perform the skill, the teacher makes annotations if screening is required. The students should be able to perform the skill independently at this stage, and opportunities should be given to them again. This stage may take longer.

6) Weekly and monthly review stage: Through this stage, students are checked whether the skill is learned or not (Güzel, 1998; Mitchell, 2008).

Participants of the Study

This section provides information on the observer, implementer, and participants of the study. This study was conducted on a total of three participants, consisting of one female and two males, attending a private special education center located at a central district of a province of the West Black Sea Region in Turkey. Code names were given and used for the participants. Three young individuals who fulfilled the prerequisite skills for marbling and stone-painting skills and diagnosed with mild intellectual disability volunteered to participate in the study. The participants who did not possess these skills were included in the study. Necessary consent forms were obtained before the the study starts, the families of the participants were contacted, and the necessary information was provided regarding the study process. Aycan, Ferdi, and Sefa were used as the code names for the participants.

Prerequisite skills were identified as follows: verbal expression, the minimum attention span of 10 minutes for audio and visual activities, following and imitating motor behaviors, fulfilling verbal instructions, being able to identify colors, and having the necessary hand-eye coordination.

The participants of the study are;

Aycan, attending a special education vocational school, is a 16-year-old female student with mild intellectual disability with a capability of independent self-care, communication, small and big muscle skills, and the modification one or two-step instructions.

Ferdi, attending vocational and technical Anadolu high school, is a 15-year-old male student with mild intellectual disability. He is capable of independent self-care, communication, small and big muscle skills, and the modification one or two-step instructions. He is also capable of mathematics, reading comprehension, and expression skills.

Sefa, attending a special education vocational school, is a 16-year-old male student with mild intellectual disability. He has reading, writing, and mathematics skills. He is capable of independent self-care, communication, small and big muscle, skills, and the modification one or two-step instructions. The students attend a private special education institution after school.

Setting

The probe, instruction, and maintenance sessions of the study, examining the effectiveness of the direct instruction method in teaching leisure activities to young IwIDs, were conducted in the group education room of the private special education center. The class has a table, chairs, and a cabinet to put the required tools-materials.

Tools-Materials

The following tools and materials were used in the probe and instruction sessions:

In marbling, an adragant vat, red and blue adragant paints, two brushes, awl, and adragant paper. In stone painting; square stones of 5x5 dimensions, red stone paint, one brush, thick acrylic paint pen, and spray polish. Yellow and green paints were used in the generalization session for marbling, whereas rectangular stones of 5x10 dimensions and green paint, thin acrylic paint pen were used in stone painting. Video recordings were made by a student attending the special education section with a video camera. Criterion-referenced test performance-recording form was used for recording the data obtained from the sessions for both marbling and stone-painting activities. The same form was used to record the data collected from the probe and maintenance sessions as well.

Skill Analyses

In the preparation of skill analysis for marbling and stone-painting skills, a specialist from the drawing department of the university, who is competent in these skills, was consulted, and the pilot interventions were conducted by an implementer. Marbling analysis consists of 12, and the stone-painting skill analysis consists of 14 steps.

Intervention Process

The study was conducted between March and July in the spring term of 2018–2019. Participants attended their education on weekdays, until 4:30 PM, at their school and came to the private special education institution on weekends, in the afternoons only. The study and intervention were conducted on a one-to-one basis with the three students. Criterion-referenced tests and performance-recording tables were prepared for the skills. Criterion-referenced tests included the statement, question, criteria, and questions. During the assessment, the single opportunity technique was used to determine how much of the target skill they can perform on their own. The sessions were held two days on weekdays and one session each day. The first baseline data were collected for all participants, and once the stable data were obtained, the probe sessions were initiated

for all participants when the criteria was met for the first participant. When all participants met the criterion, the maintenance, and generalization sessions were started one, three, and four weeks later. First, marbling and then stone-painting skills were taught.

Probe Sessions

Full and daily probe sessions were held in this study. Full probe sessions of simultaneous three sessions were held for each participant after the participant who was taught to collect the baseline information before the initiation of teaching. Daily probe sessions were organized during the instruction session to constitute the intervention data of the study for the participant who was being taught. A trial was made in each probe session, and this was assessed over 100% with the reactions given by the participants being taken into consideration in the data collected.

An attention-drawing stimulant like "Now, we will do marbling together. Are you ready?" was given for marbling in the probe sessions. When the participant expressed readiness, skill prompt was given in the form of ". Do marbling." An attention-drawing stimulant was given in the form of "now we will paint stone with you. Are you ready?" for stone painting in the probe sessions. When the participant expressed readiness, verbal reinforcement was made with "well done," now "..... paint the stone" instruction was issued. Response time of five seconds was set for the first step of the skill to be done by the participant, and a response was expected in this period. An A (+) sign was placed on the data collection form in the skill analysis when the skill step was achieved, and an a (-) sign was placed in the event of a wrong response. Sessions were ended when the participant gave an incorrect answer. The probe sessions lasted approximately 10 minutes.

Instruction Sessions

Marbling instruction sessions were held in the group education room in the private special education institution. A cue was given for marbling like "Now, we will do marbling together. Are you ready?" and reinforcement was provided when the participant expressed their readiness. The participant stood on the right side of the implementer. Marbling materials were prepared on the table in advance. The materials were introduced to the participant, and attention was drawn to the activity. In the modeling phase, the implementer dipped the brushes in the paint containers in front of them, sprinkled this on the adragant container, and shaped it with an awl. The implementer guided the participant by placing the adragant paint on the container, then lifting it and leaving it to dry. During the guided interventions phase, the same skill steps were repeated with guidance. In the independent intervention phase, a "do marbling" skill prompt was given to the participant, and the participant was requested to do the skill without assistance; daily assessments were made after the independent intervention phase. Data regarding the daily assessments of the target skill were obtained at this phase and transferred to a graph.

Stone-painting instruction sessions were also held in the group education room in the private special education institution. A cue was given to the participant to draw attention like "now we will learn stone painting with you. Are you ready?"

Before starting teaching, an unpainted stone, acrylic paint, and acrylic pen were prepared. The implementer stood on the right side of the participant. The materials were introduced to the participant, and attention was drawn to the activity. During the modeling phase, the implementer painted all the surfaces of an unpainted stone with a brush, left it to dry, and made patterns with dashed lines on the previously painted-dried stone with an acrylic pen to model for the participant. During the guided interventions phase, the same skill steps of the instruction process were repeated with guidance provided to the participants. In the independent interventions phase, "paint the stone" instruction was given to the participant, and he/she was expected to realize the skill without assistance. Daily assessments were made after the independent intervention phase. The data regarding the daily assessments of the target skill were obtained at this phase and transferred to a graph. The instruction sessions lasted approximately 20 – 25 minutes.

Maintenance and Generalization Sessions

The maintenance sessions of the study were conducted to determine whether the participants could achieve the skills that they learned one, three, and four weeks after the instruction was completed, with the same method used on a one-to-one basis by the researcher with the participants in the probe sessions.

Generalizing sessions of the study were held to determine whether the participants could generalize the skills that they learned with different settings, materials, and people. No cues were given in the generalizing sessions, like in the probe sessions. Generalizing sessions were held in a kitchen in the private special education institution accompanied by an institution's teacher with different materials. The teacher gave the skill prompt like "do marbling" in marbling and "paint the stone" in the stone painting and provided reinforcements at the end of the session saying something like "well done, this is very nice." The maintenance and generalization sessions lasted approximately 20 – 25 minutes.

Reliability

The inter-observer reliability of the study was calculated with the following formula: "number of agreements / [number of agreements + number of disagreements] 100" (Tekin-Iftar & Kırcaali-Iftar, 2004). The reliability calculation was made in 30% of the probe, instruction, maintenance, and generalization sessions of the study. The reliability of the study data was obtained from a lecturer with a doctorate degree, who had been working at the special education department of a university for 25 years and who is competent and experienced in the field of special education. In the study, the reliability percentages for the full probe sessions were 100% for marbling and stone painting; the inter-observer reliability percentages were 100% for marbling and stone painting; the inter-observer reliability percentages for maintenance sessions were 100% for marbling and stone painting; and the inter-observer reliability percentages for generalization sessions were 100% for marbling and stone painting.

The data collected for the intervention reliability of the study were calculated using the following formula: "observed implementer behavior/planned implementer behavior x 100." (Tekin-İftar & Kırcaali-İftar, 2004).

The intervention reliability of the study data was collected in 30% of the sessions of the study by considering the following issues:

a) Target stimulus
b) Control of tools-equipment
c) Drawing attention
d) Presenting a target stimulus
e) Modeling
f) Doing together
g) Doing independently
h) Reinforcement of student's behavior
i) Feedback/correction

Intervention reliability of the study data related to all participants and all the behaviors were found as 100% for marbling and stone painting.

Data Analysis

The effectiveness of the study data was analyzed with the graphical analysis method. The correct behavior percentages of the participants were shown with equal intervals of 0–100 in two separate graphs with the probe, generalizing, instruction, and maintenance sessions on the horizontal axis and marbling and stone-painting skills, which are the dependent variables of the study on the vertical axis. Whether the experimental control was established in the study or not was determined by only the intervention of the independent variable diachronically to the variability of the dependent variable.

The social validity of the study data was collected from the parents of the participants. The following questions were directed to the parents of the participants, and their answers were assessed with descriptive analysis:

1. What are your opinions on the activity applied to your child?

2. What are your opinions on the skills applied to your child?

3. What kind of benefits will this activity provide for your children?

4. Is there anything you want to add?

Findings

This part summarized that the findings on the effectiveness of the direct instruction method in teaching marbling and stone-painting skills to young IwIDs and the maintenance and generalization of the skills.

Findings on the Effectiveness of the Direct Instruction Method in Teaching Marbling skill

Aycan

Aycan achieved 15% performance in the baseline sessions. When the stable data were obtained in the baseline data, instruction sessions were initiated. Five instruction sessions were held in teaching the skill, which was continued until the criterion was met at the level of 100%. In the probe sessions after the instruction sessions, skill steps were conducted with a 100% success in the generalization and maintenance sessions. Under the light of these findings, it is seen that Aycan acquired, maintained, and generalized the skill of marbling with the direct instruction method.

Ferdi

Five instruction sessions were held with Ferdi. He achieved 15% performance in the baseline sessions that were held before the launch of the instruction. This rate increased to 100% at the end of the instruction sessions. No changes have occurred in the success status of Ferdi in the probe sessions held after the instruction sessions. The success level was 100% in the maintenance data and generalization sessions. Considering these findings, it is seen that Ferdi acquired, maintained, and generalized the skill of marbling with the direct instruction method.

Sefa

Five instruction sessions were held with Sefa. He attained 15% performance in baseline sessions. This rate increased to 100% after the second instruction session. The success level was 100% in the maintenance and generalization sessions achieved after the instruction sessions. Under the light of these findings, it is seen that Sefa acquired, maintained, and generalized the skill of marbling with the direct instruction method.

Findings on the Effectiveness of the Direct Instruction Method in Stone-painting Skill

The data obtained regarding the teaching of stone-painting skills for all participants are presented in Figure 2.

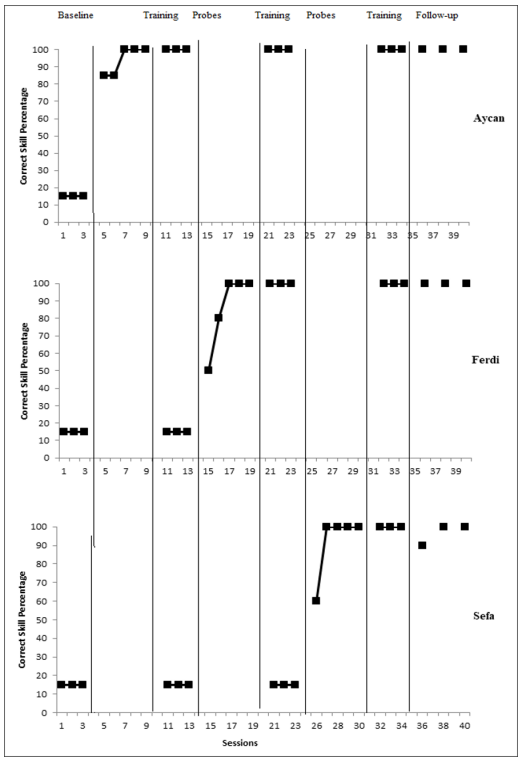

Figure 1. Marbling Data

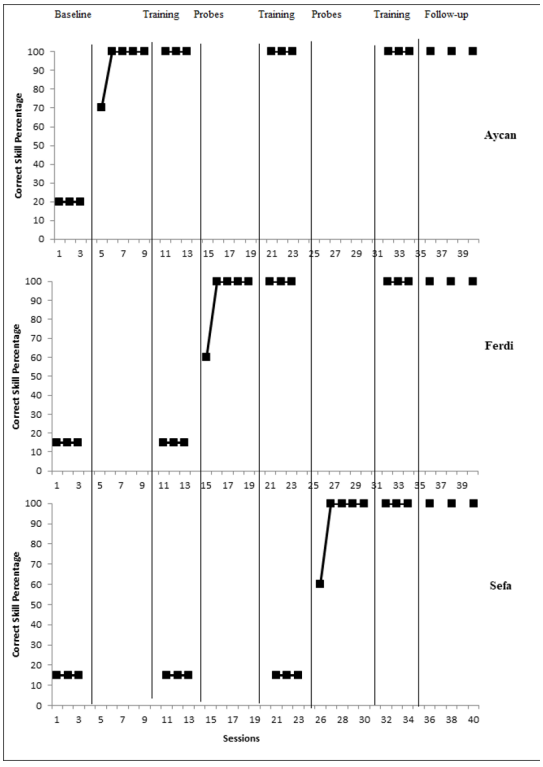

Figure 2. Stone-painting Data

Aycan

Aycan presented 15% performance in the baseline sessions. When the stable data were obtained in the baseline data, the instruction sessions were started. Five instruction sessions were held with her, and it was seen that the criterion was met at a 100% level. A drop was seen in the following full probe data in the success level. The success level was 100% in the maintenance and generalization sessions. The findings depicted that Aycan acquired, maintained, and generalized the skill of stone painting with the direct instruction method.

Ferdi

Five instruction sessions were held with Ferdi. He attained 15% performance in the baseline sessions, and it was seen that he met the criterion at a 100% level in the first session held after the stable data were obtained. Skill steps were realized with a 100% success in the full probe sessions. His success level was 100% in the maintenance and generalization sessions held after the instruction sessions. The findings depicted that Ferdi acquired, maintained, and generalized the skill of stone painting with the direct instruction method.

Sefa

Five instruction sessions were held with Sefa. He attained 15% performance in the baseline data, and it was seen that he met the criterion at a 100% level in the first teaching session after the stable data were obtained. Sefa achieved a 100% success in the maintenance and generalization sessions. The findings revealed that he acquired, maintained, and generalized the skill of stone painting with the direct instruction method.

In addition to the findings given above, the implementer observed that all participants were happy during the intervention of the skills and performed their skills happily and willingly. The participants would say "Please start with me first" at the interventions of the study. When attaining the skills steps of the instruction sessions, Ferdi also expressed his happiness verbally. For example, "I am now dipping my brush in the paint, sprinkling my paint on the tray, and making shapes," "first, I am painting the front face, ... Now I am drawing my lines with the pen, polishing."

Social Validity Findings

A social validity form, consisting of four questions, was created in consultation with a specialist to obtain findings related to the social validity of the study, and these were applied to the parents of the participants with the interview method. The interviews were conducted at the end of the intervention by the implementer of the study in the principal's room of the institution. Aycan's father and Ferdi and Sefa's mothers participated in the interviews. The interviews took 15–20 minutes

Opinions of the Parents on the Intervention

1. "It was a good intervention; I am pleased, it took her one step further."

2. "I am satisfied. It was a different kind of fun for him. He came here happily and willingly. I am very pleased. His skills have developed."

3. "It was very nice for his. It prevented his from closing himself at home. It was very good for him.

Opinions of the Families on the Skills Applied

1. "She was very restricted; the intervention helped her eliminate these restrictions. It helped her improve writing skills and made progress."

2. "They were very good activities that helped him develop; they guided him and developed his creativity."

3. "He does not talk much about what he did, but both activities were nice and beneficial."

Opinions of the Families on the Kinds of Benefits Provided by the Intervention to Their Children

1. "Contributed to her reading and writing skills, I do not see any missing issues. It was very useful for the future. I hope she becomes an artist. It helped her make great progress."

2. "Drawing and art activities are not provided at school very much. I really want these activities to continue and help my child develops if he has talent."

3. "The activities have increased his self-confidence. He mainly spent his time on the computer. I am very happy that he is engaged in a different activity. These activities prevented her from getting bored at home and reduced his ill-temper."

Discussion

This study examines the impact of the direct instruction method on teaching marbling and stone painting as leisure skills to young IwIDs. The study also examines whether the learned skills are maintained one, three, and four weeks after teaching and whether the taught skills can be generalized to different people, settings, tools, and equipment.

Study findings indicate that the participants acquired the skills regarding marbling and stone painting and maintained their skills and generalized them with different people, settings, and tools-equipment. As Figure 1 and Figure 2 depict, the number of instruction sessions of the participants is close to each other. To ensure that the participants can perform to meet the criterion, it can be said that individuals with similar cognitive characteristics were selected in terms of prerequisite conditions during the selection of the participants. The literature review showed that studies were conducted on the effectiveness of individualized teaching materials in the teaching of leisure skills to IwIDs (Demir, 1996; Özokçu, 1997; Eratay & Güler-Özkan, 2004). Even though the analyses of the study were conducted with a different method, there are similarities between the findings in terms of partial effectiveness.

Moreover, the participants learned, maintained, and generalized the skills in the studies in which leisure skills were taught to IwIDs with the simultaneous prompting procedure in the single-subject research model (Çankaya & Eratay, 2011; Leblebici, 2012; Gökmen, Tekinarslan & - Çifçi Tekinarslan, 2014; Çulha, 2010; Aslan, 2009; Aslan & Eratay, 2009; Yücesoy-Özkan & Gürsel, 2006; Özbey, 2005; Topsakal, 2004, Eldeniz-Çetin & Çay, 2016). In this aspect, the findings of this study are in line with the findings of the studies on the effectiveness of simultaneous prompting procedure. Also, in studies in which video-modeling was used for teaching leisure skills to IwIDs, the participants learned, maintained, and generalized the skills (Aykut et al., 2014; Ulugöl, 2018; Eldeniz-Çetin & Ulugöl, 2017; Chan et al., 2013; Hammond et al., 2010; Zhank et al. 2004). The study findings have some similarities with the results of the aforementioned studies in this aspect.

Moreover, the findings of this study have a partial similarity with the findings of the study on the effectiveness of activity schedules in IwIDs (Arslan, 2017) and studies in which leisure skills were taught to children with autism spectrum disorders using the errorless teaching method.

It is safe to say that studies on teaching leisure skills were mainly conducted using multiple probe design with probe conditions across participants of the single-subject research model. This study has similarities and parallelism with other studies in terms of this aspect as well.

Eldeniz-Çetin and Ulugöl (2017) taught marbling skill, which was taught with the direct instruction method in this study, to young IwIDs with video modeling. It is interesting that even though the same skill was taught with different methods, the individuals acquired, maintained, and generalized this skill, so it is also possible to say that there is parallelism here.

Studies on teaching playing games on a tablet or computer (Eliçin & Kaya, 2016) and fixing blown tires (Çay, 2019) to IwIDs with the direct instruction method have similarities and overlap with the findings of this study in terms of the effectiveness of the direct instruction method.

The findings of studies examining the opinions of the teachers and parents on leisure activities revealed that adequate activities for these individuals were not available at schools (Çay & Eldeniz-Çetin, 2017); successful results were obtained from the activities that children benefitted (Eratay et al., 2016); and that children mostly spent time at their homes (Çay & Eratay, 2019; Eratay, 2013; Bayram, 2016). Regarding the social validity findings, the parents stated that they were very happy with the activity because they thought it contributed to the development of their children. They also expressed that the intervention was beneficial, and there were no such activities in their schools. Social validity findings support the findings of Çay & Eldeniz-Çetin (2017), Eratay et al., (2016), Çay & Eratay (2019), Eratay (2013), and Bayram (2016).

In the study, the parents stated that the aggressiveness of their children mitigated, their children were bored at home and that the activity increased their self-confidence. These findings of this study support the studies and opinions that leisure activities promote trust and courage and provide behavioral therapy (Aksu, 2011; Kaya, 2019; Sukan, 2013; Yaman, 2015). Moreover, Ferdi expressed the skill steps verbally during the sessions. This finding is consistent with the findings of Aksu (2011) that artistic activities improve the ability of self-expression.

Some studies postulated that the participation of IwIDs in leisure activities is limited (Dusseljee et al., 2011; Ziljstra & Vlaskamp, 2005; Bertilsdotter-Rosqvist, 2015; Armila, Rannikko & Torvinen, 2018). This study could be argued to be important in terms of providing an opportunity for these young individuals with limited participation in these activities. At the end of the study, the skill tools and equipment used in the study were gifted to the institution to provide an opportunity to use them for other individuals who were not included in this study.

Mactavish & Mahon (2005) claim that individual-oriented activities are more satisfying for these individuals. The fact that the children were highly motivated in the study, they were very happy with the activity, and the individual-orientedness of the activity supports the opinions of Mactavish & Mahon (2005).

Conclusion

The study examined the effectiveness of the direct instruction method in teaching marbling and stone painting as leisure skills among young IwIDs. The inter-observer reliability of the study was 100% for full probe, daily probe, maintenance, and generalization sessions in marbling and stone painting. The implementation reliability of this study was 100% for all participants and behaviors. The participants learned the marbling and stone-painting skills taught with the direct instruction method, and maintenance and generalization were attained. As for the social validity findings, the parents stated that they were very happy with the activity and that it was beneficial for their children.

The use of the direct instruction method and a small number of participants may be a limitation of the study. Regarding the recommendations on the intervention, it can be recommended that the direct instruction method is used in the teaching of leisure skills by IwIDs' teachers. Different leisure time skills such as glass mosaic making, kite making, glass painting, and macramé making can be taught through this method. The research was conducted in an individual study class in a private education center. Considering that it was an artistic study, some difficulties were encountered in the classroom from time to time. Such a study can be better conducted in a workshop class. The painted papers removed from the vat during the marbling works were dried on the radiators. From time to time, paint dripped from the paper. At the end of the study, the implementer cleaned the paint stains on the floor. As the paints used during the interventions were selected from the paints, they did not leave a stain on the floor and come out quickly when washed or wiped with a wet towel. During the research, there was no stain on students' clothes. However, aprons and gloves can be used in marbling and stone-painting activities. Some of the study products were given to students when they were dry, and they were allowed to take them home. Some products were delivered to the institution to be placed in the students' files. However, the study could not be exhibited because the end of the study coincided with a holiday. It is important that students' work is to be presented to teachers, parents, and other visitors. The products of the intervention can be exhibited. A very simple method was employed in marbling. More complex patterns, such as tulip making, can be implemented. In stone painting; square and rectangular stones and line drawing on the stone were used. With different stones, for example, oval, circle stones, or large size stones, animal figures, mandala patterns can be examined. In future studies, marbling and stone-painting skill may be taught with the direct instruction method to children with different disabilities and in different settings or as individual and group teaching. Leisure skills may be obtained through different methods. In addition, at the end of the study, the materials and equipment used in the study were given to the institution as gifts for the use of other individuals. The teaching of artistic activities can be added to the school curricula so that neglected leisure time activities can be compensated. Programs for teaching leisure activities for teachers and families can be organized. Free time activities where families and young people attend can be arranged (For example, the whole school is going on a picnic together, parents and young people attending a drama event). In this research, individual education was provided. Future studies should examine the activities in which young people with and without disabilities participate together in inclusion settings. In this study, The perceptions of the parents were collected. Future studies may examine the perceptions of teachers and participants. The direct instruction method used in teaching leisure skills may be used with other methods to compare their effectiveness and efficiency.

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"Errorless" Toilet Training: "The Potty Party"

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Abstract

The current study describes the use of a procedure called the "potty party", an all-day toilet training method using basic learning principles of "errorless" discrimination with 3 children with incontinence diagnosed with autism. At the start of treatment days, each participant was greeted and prompted to request the bathroom. After the child requested the bathroom, they were taken to the restroom, pants and underpants were removed, the child was seated on the toilet. While on-seat, participants were given liquids, less-preferred reinforcers and engaged in typical daily activities such as discrete trial training. When the child voided in the toilet, specific verbal praise and highly preferred edible reinforcers were delivered. The child was also given time off the toilet with their most preferred toys or items/activities. Time off-toilet subsequently increased with each in-toilet urination until the participants were spending the same amount of time off-toilet, out-of-bathroom, and in the classroom as their peers. Results for all three participants using 3 non-concurrent A-B phase designs indicated that the potty party procedure was effective in decreasing accidents to zero levels for all three participants and increased in-toilet urination for two. Future directions for research in toileting are discussed.

Keywords: Toilet Training, Autism, Errorless Learning, Applied Behavior Analysis

Introduction

Learning to use the toilet is a critical life skill (Francis, Mannion, & Leader, 2017; Kroger & Soren-Burnworth, 2009). However, many children with autism and other developmental disabilities have difficulty acquiring this skill and can enter their teen years or go their entire lives without mastering toileting. Therefore, it is desirable to have effective protocols to teach toileting. Almost all modern toileting protocols are based on the Rapid Toilet Training (RTT) method developed by Azrin and Foxx (1971). In the RTT method, Azrin and Foxx describe toilet training as "a complex and lengthy chain of responses that includes social, physical and physiological stimuli and requires strong positive and negative operant consequences for its maintenance in that chain, rather and considering it as a simple associative muscular reflex to internal stimuli" (p. 98). These protocols generally include graduated guidance, reinforcement, scheduled sittings, hydration, and stimulus control procedures involving changing controlling antecedents from "other" (e.g., diapers) to toilet (Kroeger & Sorensen-Bunworth, 2009).

Errorless Learning and Toileting

Because errorless learning "can create situations in which limiting the incorrect response in a learning task is ideal" errorless learning may be a preferred procedure to use with children with developmental disabilities such as autism that often display "response overselectivity and overgeneralization combined with problematic behaviors in response to failure or novel tasks" (Mueller, Palkovic, & Maynard, 2007, p. 695). Errorless learning or "errorless discrimination" was developed by Herbert Terrace (1963) initially to teach color discrimination to pigeons. Terrace presented the target color (discriminative stimulus, S^d) brightly to the pigeon for extended periods of time (3 minutes) and presented the incorrect color (S^Δ) dimly for only a brief period of time (5 seconds). This method made it very likely pigeons would respond to the S^d and made it very unlikely that they would incorrectly respond to the S^Δ. As correct responding increased and errors remained virtually nonexistent, the duration of the S^Δ and its brightness gradually increased until they were equal to the duration and brightness of the Sd. This procedure resulted in a reduction of errors from several thousand, with conventional discrimination training, to 25 or less with "errorless" learning. Few errors occur because the appropriate situation or setting for a correct response is in effect for extended periods of time while the conditions under which errors may occur are presented only briefly.

The present study investigated an approach to errorless toilet training described in teaching circles in Northeast and Central Ohio as the "potty party". This approach, however, is different than other interventions called potty parties in several self-help books for parents on toilet training their child (e.g., Crane, 2006; Williamson, 2012). The potty party method described here aims to make sitting on the toilet a reinforcing activity (a party), keeps the child on the toilet from the beginning of the day until successful voiding in the toilet occurs, and increase time off toilet gradually throughout the day contingent on success of the learner. Powerful reinforcers including social and tangible consequences, are delivered contingent on successful voiding. The probability of success is maximized because the potty party method utilizes procedures of errorless discrimination training in that the child is sitting on the toilet for long durations of time and is thus substantially more likely to void in the toilet. The potty party method is conceptually in agreement with both RTT and Terrace's (1963) conception of toileting as an operant response that is susceptible to training by operant procedures such as reinforcement and errorless learning that can produce stimulus control by exteroceptive stimuli as well as internal stimuli such as a full bladder. In addition to creating an ideal situation for toilet training where the probability

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of an accident is virtually zero, the procedure also employs established behavioral techniques such as contingent positive social/tangible reinforcement, consistent scheduling, and teaching functional requesting. To our knowledge, no study has investigated the effectiveness of the potty party to teach toileting to children with autism. Therefore, the current study investigated the potty party for its effectiveness with teaching toileting to three children with autism in an initial attempt to establish its empirical validity.

Method

Participants

Three males ages 4 (Joey), 6 (Billy), and 8 (David) enrolled full-time at a center for autism in Northeast Ohio were selected for inclusion in the current study (names reported are pseudonyms). Each had a previous diagnosis of autism and exhibited (by observation and teacher report) at least some of the physical and behavioral readiness to begin toilet training such as imitative behavior, ability to sit without assistance, expressing a need to urinate, dressing and undressing, and other self-management skills (Kaerts, Van Hal, Vermandel, & Wyndaele, 2012). Consent for participation was gained from the parents of the participants and approval was obtained from the university Institutional Review Board (IRB).

Setting

Training took place in the bathroom and classroom of the autism center that participants attended. Both settings were familiar to the participants. The first 1-2 days of training took place in the bathroom. The bathroom was equipped with three stalls, one of which contained a child-sized toilet, approximately 0.30 meters (1 foot) from the floor to the top of seat (used by Joey and Billy) and two which contained adult-sized toilets, approximately 0.46 meters (6 inches) higher than the child-sized toilet (used by David). The bathroom provided enough space outside of the stall to allow, during "off-toilet intervals," for the participant and experimenter to engage in other activities including one-on-one discrete trial work times, snack time, and leisure/play. The remainder of the intervention was spent in the participant's regular classroom once he was able to remain off the toilet for extended periods of time.

Procedure

Baseline

Prior to beginning the study, reinforcers for each participant were determined through preference assessments conducted by the experimenter and/or indirect reporting from parents and teachers. Data was collected by the participant's primary teacher or the experimenter (who was also a full-time teacher at the center) on the number of accidents the participant had during the school day and the number of times he urinated in the toilet throughout the day. The number of accidents the participant had was determined by checking his diaper or pull-up for wetness every thirty minutes throughout the school day. If the participant was wet, the teacher or experimenter would count this as an accident, change the participant, and check him again after another thirty-minute interval. Baseline data was collected for four days prior to intervention for all 3 participants.

Intervention

Upon entering the building at the start of the school day, participants were greeted by the experimenter and were prompted to request the bathroom through the use of the picture exchange communication system (PECS) or through the use of the child's speech generating device (SGD). Joey was prompted to request the bathroom using the picture exchange communication system (PECS) with a picture icon with the written word "bathroom" and a picture. Participants B and C were gesturally or physically prompted to use their SGD to request the bathroom by selecting the icon that corresponded to bathroom. After prompted requests, the child was then taken to the restroom, was prompted to remove his pants and underwear, and was seated on the toilet facing forward with feet placed on the floor.

While the child sat on the toilet liquids were offered and consumption of snacks was encouraged. Salty snacks were offered to encourage the participant to request and increase their fluid intake. The most preferred snacks identified in the participant's preference assessment were withheld to be used as reinforcement specifically when the child successfully voided on the toilet. While seated on the toilet, the participants engaged in other various activities including playing with moderately preferred toys, reading or singing with the instructor, and engagement in discrete trial work times with the experimenter. As required by the physical therapist on the university's IRB, each participant was also prompted, during the on-toilet intervals, to stand up, shake his legs, stretch, or jump every 10 to 15 minutes in order to prevent any discomfort from extended sitting. Otherwise, the child remained seated on the toilet.

Contingent on the participant successfully voiding in the toilet, descriptive verbal praise was delivered from the experimenter ("Yeah! Great job! You put pee in the potty") and the most highly preferred edible reinforcers identified in the preference assessment were delivered. After successful elimination had been reinforced with praise and edibles, the participant was given underwear to put on and was given his most preferred toys or reinforcing items/activities to engage with as further reinforcement for successful toileting. The participant was then allowed to remain off the toilet for three to five minutes. The specific initial length of the participant's break was determined prior to implementation of the potty party and was based on the child's age and teacher's and experimenter's judgment as to how long the child would be able to remain off the toilet without an accident.

During the off-toilet interval, the experimenter provided praise for the child's previous urination in the toilet and for remaining dry during the period that he was not seated on the toilet. If during time off toilet the participant had an accident the experimenter provided a brief verbal correction ("No, we pee in the potty") in an attempt to stop the flow of urination. The participant was immediately taken to the toilet so that they could finish urinating in the toilet. If they did not finish on the toilet, the client was prompted in a neutral tone to change clothes. The participant was provided new underwear and was again prompted to ask for the bathroom and was sat on the toilet in order to repeat the process. If the participant, however, finished in the toilet after the beginning of an accident, this behavior was reinforced, and the participant was again provided time off of the toilet as described above.

For each successful in toilet urination, the time spent off of the toilet increased by 5 to 10 minutes each time until the child was able to spend a long enough period of time off of the toilet to rejoin classroom activities. Following an accident, the next successful in toilet urination resulted in time off toilet that reverted to last successful interval time without an accident.

Interobserver Agreement

Inter-observer agreement (IOA) was obtained from experimenter's data and the participant's primary teacher who collected data during 40% of days during the study on accidents and successes in the toilet. IOA was calculated using total count IOA in which the smaller number of observed frequencies was divided by the larger number of observed frequen-

cies (Reed & Azulay, 2011). IOA for number of accidents and the number of in-toilet urinations was 100%.

Research Design

The effectiveness of the potty party in increasing successful urination and decreasing accidents was evaluated using a non-concurrent AB phase design replicated across three participants. The AB design, which is sometimes referred to as the interrupted time series design, displays responding across baseline and intervention phases. The AB design "is one of the most basic and practically feasible experimental designs for evaluating treatments in single-case research" (Michiels & Onghena, 2019, p. 2456). The AB design does not control for all threats to internal validity, but often is used in instances in which baseline durations and treatment initiations cannot be systematically altered due to ethical or logistical constraints. Internal validity of the AB phase design, however, can be increased with replications of the effect (Michiels & Onghena, 2019). Six to nine days after instruction a maintenance probe on frequency of accidents and independent in-toilet urination was taken to assess for maintenance of behavior change.

Results

Results indicate the potty party method was successful in both increasing participants' in-toilet urinations and in decreasing the number of accidents (see Figure 1). Joey successfully urinated in the toilet on 0 days in baseline and had 2-3 accidents per day in baseline. Billy successfully urinated in the toilet on 0 days in baseline and had 1-3 accidents per day in baseline. David successfully urinated in the toilet on 0 days in baseline and had 2-3 accidents per day in baseline. After the introduction of the potty party, Joey immediately increased his successful in-toilet urinations from 0 to 7, with a gradual reduction from 2-3 accidents a day for the last 2 days of baseline to 0 accidents for the last 2 days of intervention. Frequency of in-toilet urination remained steady throughout the intervention and ranged from 7 to 9 a day. Billy immediately increased his successful in-toilet urinations from 0 to 2 with a gradual reduction from 2-3 accidents a day in the last 2 days of baseline to 0 accidents for the last 2 days of intervention. Billy exhibited low levels of both accidents and in-toilet urination during the intervention condition. Frequency of successful in-toilet urination for Billy ranged from 0 to 2 throughout the intervention. Lastly, David immediately increased his successful in-toilet urinations from 0 to 10, with a gradual reduction from 2 accidents over the last 2 days of baseline to 0 accidents in the last 2 days of intervention. Frequency of in-toilet urination for David remained steady throughout the intervention and ranged from 7 to 9 a day. Due to the frequent success in urinating in the toilet, all 3 participants were able to begin transitioning back into their classrooms for various durations by the end of day 6. Follow-up maintenance probes conducted showed a maintenance of elevated frequencies of urination for Joey and David and maintenance of zero levels of accidents for all 3 participants.

Two non-parametric non-overlap indices of effect size between baseline and intervention phases were also computed: Percentage of non-overlapping data (PND) and percentage of percentage of data points exceeding the median (PEM; Wolery, Busick, Reichow, & Barton, 2010). To calculate PND for behaviors to increase (in-toilet urination), the highest data points in the baseline was compared with successive data points in the intervention phase. The percentage of intervention points exceeding the highest point in the baseline phase was calculated. Conversely, for behaviors to be decreased (accidents), the lowest data point in the baseline was compared with the data points in the intervention condition. The percentage of intervention points below the lowest point in the baseline phase was calculated. Qualitative descriptions based on those described by Scruggs and Mastropieri (1998) are also provided for all 3 participants across both behaviors. Using these criteria, the intervention can be described as "effective" or "very effective" for Joey and David. The intervention's effectiveness was questionable for Billy using these criteria.

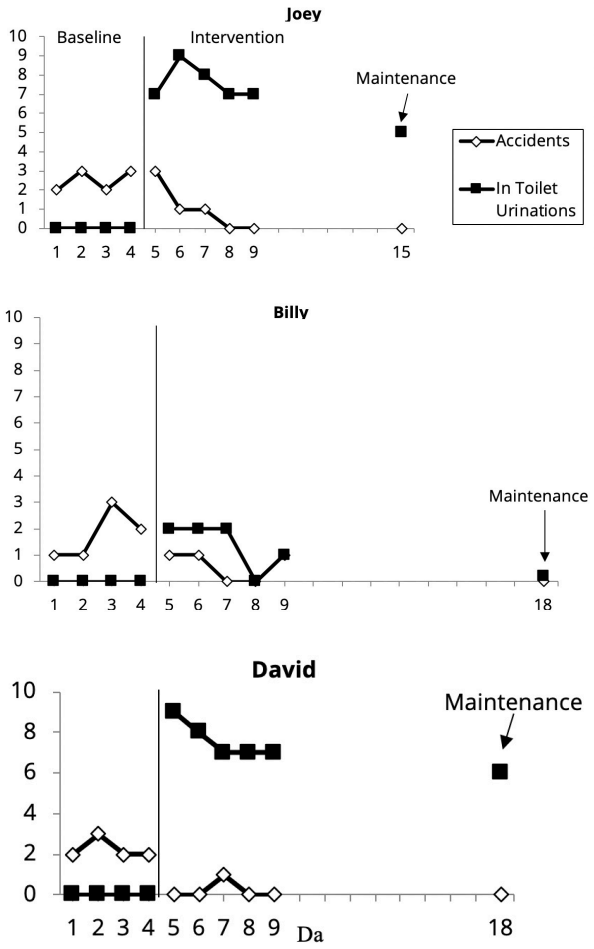

Figure 1. Frequency of accidents and in toilet urinations during baseline, treatment and maintenance for the three participants

Table 1. *Percentage of non-overlapping data (PND) for accidents and successful urination for all 3 participants*

Participant	Accidents	Description*	In-Toilet Urination	Description*
Joey	83% (5/6)	Effective	100% (6/6)	Very Effective
Billy	50% (3/6)	Questionable	67% (4/6)	Questionable
David	100% (6/6)	Very Effective	100% (6/6)	Very Effective

*Qualitative descriptions based on those offered by Scruggs and Mastropieri (1998)

PEM was calculated in addition to PND because it has been reported to offer advantages over PND, notably the influence of ceiling and floor effects (Ma, 2006). To calculate PEM for behaviors to increase (in-toilet urination), the median of all the data points in the baseline was compared with successive data points in the intervention phase. The percentage of intervention points exceeding the median in the baseline phase was calculated. Conversely, for behaviors to be decreased (accidents), the percentage of data points below the median of the baseline phase was compared with the data points in the intervention condition. Qualitative descriptions based on those described by Heyvaert, Saenen, Campbell, Maes, and Onghena (2014) are also provided for

all 3 participants across both behaviors. Using these criteria, the intervention can be described as "effective" or "highly effective" for Joey and David. For Billy, the intervention was "highly effective" for reducing accidents but had a "questionable" effect on increasing in-toilet urinations.

Table 2. *Percentage of data points exceeding the median of baseline phase (PEM) for accidents and successful urination for all 3 participants*

Participant	Accidents	Description*	In-Toilet Urination	Description*
A	83% (5/6)	Effective Treatment	100% (6/6)	Highly Effective
B	100% (6/6)	Highly Effective	67% (4/6)	Questionable
C	100% (6/6)	Highly Effective	100% (6/6)	Highly Effective

*Qualitative descriptions based on those offered by Heyvaert, Saenen, Campbell, Maes, & Onghena, P. (2014)

Discussion

The current study was the first to evaluate a method of toilet training based on principles of operant behavior including errorless learning and reinforcement called the potty party. Results indicated that the procedure was quick and effective for increasing in-toilet urinations for 2 of 3 participants and accidents showed a gradual reduction to 0 levels for all 3 participants. The potty party was comparable in its effectiveness and expediency when compared to other methods (e.g., Cicero and Pfadt, 2002; Keen, Brannigan, & Cuskelly, 2007; Kroger & Soren-Burnworth, 2009). By decreasing the total amount of time necessary to toilet train, the potty party can alleviate much of the stress of toilet training. Further, the potty party has the potential to reduce errors, limits the need for additional material (e.g., videos, models), uses no punishment procedures, and is a concise procedure that is consistent with established principles of behavior analysis.

The potty party is likely successful and unique in its approach to toilet training because it is an application of errorless learning. The problem of toilet training may be conceptualized as a problem in discrimination training: The toilet should function as the discriminative stimulus (Sd) for urination, while clothing covering the body should function as an SΔ for the response of urination. The existing behavior of urination is brought under stimulus control. Given this conceptualization, it should not be surprising that an effective method for training discriminated responding from basic research (Terrace, 1963), would be effective for teaching discriminated responding in applied situations such as toilet training children with autism. Especially in early training, errorless discrimination minimizes the probability of error and maximizes the probability of correct discrimination (urinating in the toilet not in one's pants). Thus, the opportunity for discriminated responding is increased and the subsequent contingent positive reinforcement is more likely to occur. The procedure gradually fades the amount of time off the toilet based on the client's success in urination.

Other researchers (e.g., Hanney, Jostad, LeBlanc, Carr, & Castile, 2012) have with some success used intensive sitting schedules and then thinned the schedule as in the current study. However even during the most intensive stages in these studies, participants sat for only 10 minutes and then were off for 5 minutes, and continence took "approximately 2 weeks" to attain (p. 26). In the current study, participants sat longer and subsequently showed increases in frequency of in-toilet urination relative to baseline, with all participants showing gradual reductions in accidents that were maintained in maintenance follow-up probes.

Limitations and Directions for Future Research

The current study did not incorporate a traditional experimental design as the baselines were 4 days for all participants. This may threaten the internal validity of the study. However, the replication of the effects of the intervention with 3 participants across the 2 behaviors being tracked in this study increases the confidence with which effects can be attributed to the potty party intervention. Changes in level were noted for all 3 participants with regard to toileting with decreasing trends of accidents to 0 levels for all 3 participants occurring as well. The results meet the scientific criteria for determining the validity of results delineated by Martin and Pear (2015, p. 221). Specifically, the results were repeated in all three participants, there were few overlapping data points between baseline and treatment, the effect was large and observed soon after treatment began, procedures were specified, responses (accidents and in-toilet urinations) were reliably recoded, and the finding extend accepted behavioral theory (errorless learning). Two non-parametric non-overlap indices also indicated that the intervention was highly effective. Future research should, however, utilize stronger designs such as the multiple baseline design to further establish the validity of the potty party.

The potty party method described here does require a teacher, school aide, or parent to be available and give their full attention to toileting for at least one full day and requires that person to spend the better part of that day in the bathroom. This individual should have some knowledge of basic principles of applied behavior analysis (ABA). The experimenter in this study was a graduate student who was familiar with the children and had experience with the application of ABA with children with autism. Participants in the potty party were prompted to request that bathroom each day. While both parents and teachers reported instances of spontaneous requesting (Joey and David) it was not consistent for all participants and was not recorded in the study. Future research should investigate the effect of the potty party on independent requesting for use of the restroom. Lastly, the current study did not examine the potty party for its effectiveness in facilitating increases in bowel continence. This too should be investigated in future research.

Conclusion

This is the first study to our knowledge to document success in decreasing the number of accidents and increasing in-toilet, daytime urinations using a toileting procedure based on errorless learning. The procedure was effective for increase in toilet urinations for 2 of 3 participants and reducing accidents for all three participants. The potty party uses many effective behavioral techniques including contingent positive reinforcement, a consistent toileting schedule, and facilitating functional requesting. The use of errorless learning procedures has the potential to allow for the application of these established principles in a condition in which errors are much less likely to occur than in other toilet training protocols. This reduction in errors has the potential to limit frustration on the part of the caregiver and learner and above all increase the rapidity with which children with disabilities such as autism develop this important functional life skill.

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Teaching Writing—With or Without Metacognition?: An Exploratory Study of 11- to 12-Year-Old Students Writing A Book Review

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Abstract

In this contribution, we attempt to answer two research questions: (1) What effects do metacognitive questions have on students' writing skills? and (2) How do students respond to metacognitive questions? To answer these questions, we conducted an experiment with 43 students who were 11 to 12 years old. They were engaged in writing in a particular genre: book reviews. These pupils belonged to two classes at the same school, and for three weeks they experienced an instructional system combining identified principles of effective writing instruction, taught by the same teacher. They were required to rewrite their text several times, with the only difference being that in one group, metacognitive questions were introduced before, during, and after writing, unlike in the other class. A total of 172 written productions were analyzed under both conditions. Student responses in the metacognition condition were also analyzed. Our results show that students in both conditions made significant progress. But in the metacognitive condition, students made more significant progress.

Keywords: Metacognition, Metacognitive Mediation, Writing, Primary School

Introduction

Since the 1980s, there has been real interest in the issue of metacognition. Since that point, this field of research has undergone great development, occupying a major place in the field of educational psychology (Desoete & Ozsoy, 2009; Doudin, Martin, & Albanese, 1999; Veenman, 2012). Metacognition is an essential prerequisite for self-regulated learning (Dörr & Perels, 2019). Metacognition-related instruction is recognized as an effective teaching practice (Hattie, 2009; Ko, Sammons, & Bakkum, 2014). Indeed, the literature has identified the impact of metacognitive skills on academic success (Sternberg, 1998). The use of metacognition can improve academic achievement. In particular, this has been demonstrated in the area of mathematics learning and problem solving (Focant, Grégoire, & Desoete, 2006; Desoete, 2017; Hanin & Van Nieuwenhoven, 2018; Özsoy, 2011; Özsoy & Ataman, 2009). The use of metacognition encourages students to reflect on what they know, to understand the reasoning they use to solve tasks, and thus to construct new knowledge (Veenman, 2012; Zimmerman, Bonner, & Kovach, 2000). Engagement in metacognition also develops a greater sense of self-efficacy (Colognesi, Hanin, Still, & Van Nienwenhoven, 2019). This is due to the fact that learners can take a look at their work, at the development of their skills, and at their understanding of school subjects. This leads to an awareness of progress and of how one learns, and a better relationship with knowledge (Wilson & Bai, 2010).

Several studies have examined the links between metacognition and improved writing quality. Some work has shown that metacognition encompasses the processes of planning, writing, monitoring and evaluation before, during and after writing (Andrade, 1999; Schraw, 1998; Zimmerman, 1995). This is not surprising, since writing is a complex problem-solving activity (Hayes & Flower, 1980), and therefore involves a metacognitive process (Zimmerman & Kitsantas, 2007). Meta-analyses such as those by Koster, Tribuschinina, de Jong and van den Bergh (2015) or van Weijen and Janssen (2018) have highlighted that strategy instruction and the development of metacognitive strategies is an effective practice for teaching writing.

Braund and Soleas (2019) explained that "an important direction for metacognitive researchers to explore is to focus on more effective strategies to be implemented in classrooms to promote metacognitive skills" (p. 106). The authors added that " it is crucial that the next generation of teachers have a strong understanding of what metacognition is, and how best to support metacognitive skills in their classrooms" (p. 108). Indeed, in the classroom, few teachers are implementing metacognition-related activities in their practice (Depaepe, DeCorte, & Verschaffel, 2010, 2015; Vlassis, Mancuso & Poncelet, 2014). However, the teacher's role is fundamental in such implementation, because "access to metacognitive reasoning depends largely on the way in which the teacher conceives of learning activities" (Doly, 1997).

Thus, how can metacognition-related instruction be involved in the context of teaching writing? At what points can students be involved? What are the effects of this involvement on the development of students' writing skills? How do students respond when they are offered metacognitive mediations related to their writing activity? These are the aspects addressed in this contribution.

Metacognition

Researchers interested in metacognition have been trying to define this term, which nonetheless harbors a conceptual vagueness. Indeed, Veenman et al. (2006) drew attention to the multitude of notions that exist. He mentioned that "the relation of some specific terms with the overall concept of metacognition is not unequivocally defined" (p. 4). Hacker (1998) held that “metacognition includes both knowledge of one’s knowledge, processes, cognitive and affective states,

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and the ability to consciously and deliberately monitor and regulate one's knowledge, process, and cognitive and affective states" (p. 11).

Three facets of metacognition can be distinguished: metacognitive knowledge, metacognitive skills and metacognitive experiences (Desoete & Ozsoy, 2017; Efklides, 2006, 2008).

Metacognitive knowledge is used to achieve a goal (Focant, 2004; Hanin, 2018; Lester, Garofalo, & Kroll, 1989). Flavell (1976) stated that it is "a person's declarative knowledge about interactions between a person, the task and the characteristics of the strategy" (p. 19). The author explained that metacognition then refers to an individual's knowledge of his or her own cognitive processes. This metacognitive knowledge is based on both cognitive and metacognitive strategies (what), the way to implement them (how), the type of task in which it is relevant to mobilize them and the most appropriate time to do so (when), and the usefulness of these strategies (why).

Metacognitive experiences are "the judgements and feelings that an individual has about their learning and thinking" (Braund & Soleas, 2019, p. 107). They refer to what a person becomes aware of and feels when they encounter a task and process the related information (Efklides, 2008). These may be feelings of self-trust, or feelings of difficulty (Ben-David & Orion, 2013; Efklides, 2006).

The third dimension, metacognitive skills, is related to procedural knowledge, that is, knowledge of the procedure by which an individual regulates their problem-solving and learning activities (Brown, 1987; Brown & Deloache, 1978; Veenman 2005). Brown (1987) considered metacognitive skills to be the activities of planning, predicting, steering, guiding and controlling outcomes. Indeed, metacognition leads individuals to reflect on their own actions. They then become aware of the path that led them to the results obtained. They observe their mistakes, discover the reasoning that led their mistakes, and look for appropriate solutions (Veenman et al., 2006, 2012). Noël (1997) specified that once that kind of knowledge has been made conscious, the individual will carry out "behaviors", such as re-reading. These behaviors constitute what she called "regulatory actions", which are the product of metacognition and not "metacognition itself, which is a mental process" (Noël, 1997, p. 21). In the end, self-regulation is the result of metacognition: learners should use metacognitive skills to regulate and control themselves (Houart, 2017; Perfect & Schwartz, 2002).

Braund and Soleas (2019) explained that "it is imperative that students learn and practice developing all three metacognition components" (p. 107). In class, students can be questioned before, during and after the task. Questioning before should encourage them to direct and plan their actions (Colognesi & Van Niewenhoven, 2016; Veenman, 2012). Questioning during should require them to explain what they are doing and why they are doing it. Questioning afterwards should get them to evaluate their work and to project themselves doing a similar task. It is then a question of identifying successful strategies for a possible repetition of the task. These metacognitive mediations can take two forms. They can be questions asked by the teacher: metacognitive prompts (Gagnière, 2010), or they can be questions asked by students among themselves: allo-confrontations (Gagnière, 2010).

To activate metacognition, students can be asked questions. These are called metacognitive mediations. These questions may occur before, during or after the tasks. Figure 1 highlights the six types of metacognitive mediation that can take place in the classroom (Colognesi & Van Nieuwenhoven, 2016).

Prior to the task, students can be asked to engage in metacognitive mediations related to orientation and planning. Orientation involves asking students to identify the goals they want to achieve "according to the requirements of the task" (Gagnière, 2010, p. 28). Planning consists of analyzing "the information about the task and its requirements, making an inventory of available strategies, planning how to proceed, determining the stages of accomplishment" (Gagnière, 2010, p. 28). That involves a "fair representation of the activity to be accomplished" (Portelance, 1999, p. 45).

During the execution of the task, metacognitive mediations can concern two types of activities: monitoring and verification monitoring. Monitoring requires them to explain the errors they have detected, "the deviations between actions and the initial plan or the appropriate application of planned strategies" (Gagnière, 2010, p. 29). Verification monitoring commits students to talking about their approach, criticizing it, justifying. This allows adjustment decisions to be made if necessary.

After the task has been completed, two types of metacognitive mediation can be used : production evaluation and process evaluation. Production evaluation engages the student in taking stock of the production by questioning whether the objective has been achieved. But they can also identify out the positive and negative aspects, using evaluation criteria. This means having a critical attitude towards what has been produced. Process evaluation asks the student to reflect on the entire process. The student can then identify the strategies used to solve the task. They can also highlight which ones were useful, which ones they would reuse for a future edition of the task.

There are three ways in which information about learners' metacognitive activities can be solicited through questioning. First, in think-aloud protocols (Fox et al., 2011) students can be asked to verbalize aloud about their thought processes. Second, judgments of learning (Mitchum, Kelley, & Fox, 2016; Nelson & Dunlosky, 1991) involve asking students to make judgements about their ability to redo a task. It is a self-assessment measure. Third, confidence ratings (Stankow & Lee, 2008; Yeung & Summerfield, 2014) involve asking students to

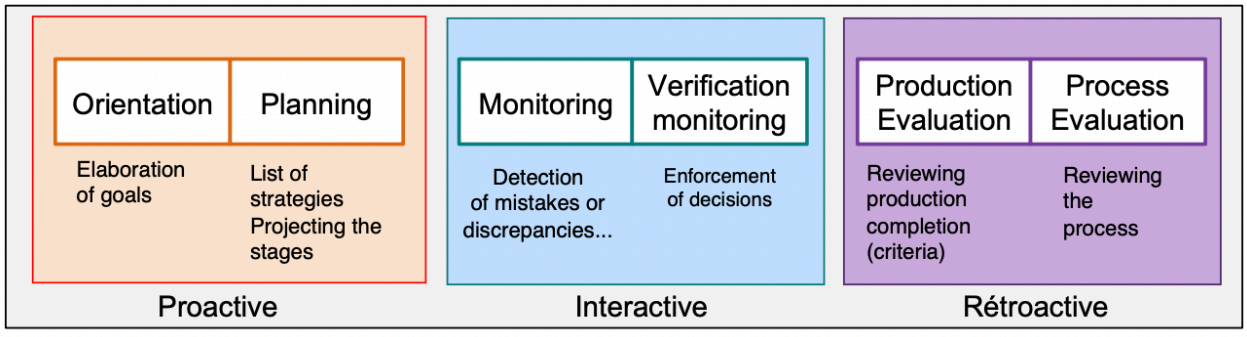

Figure 1. Six types of metacognitive mediation (Colognesi & Van Nieuwenhoven, 2016)

position themselves in relation to the task by giving a confidence rating. These three ways can occur before, during and after the task.

Metacognition and writing instruction

Teaching writing is a complex task that requires support (Hayes & Flower, 1980; Ramet, 2007). Two recent meta-analyses have highlighted four major factors that determine the effectiveness of writing instruction (Koster et al., 2015; van Weijen & Janssen, 2018). These are goal setting, peer support, feedback and instruction on writing strategies. The teaching of strategies can be linked to metacognition. Indeed, in some approaches such as the Self-Regulatory Strategy Development (SRSD) model of Harris and Graham (1996), students are taught self-regulation strategies. This is to "manage the writing process, as well as declarative and procedural knowledge about writing" (Koster et al., 2015, p. 256). In this respect, the research has shown that the most successful writers are those who can consciously use self-assessment criteria to check the quality of their writing, especially during revision (Zimmerman & Risemberg, 1997).

Graham, Harris, and Mason (2005) observed the relationship between metacognitive strategies and writing performance in an experimental study, in which, students were asked about the strategies they used to plan and write their assignments. The results of the study showed that students who explained their method improved in their writing. By studying university students who wrote an argumentative text, Escorcia and Fenouillet (2011) also showed that metacognition is strongly linked to the production of better quality texts. Their study was done on the basis of questionnaires and analysis of the written products. The results showed that the best performing students had more information about the activity and showed a better understanding of their strategies.

Several studies have shown that metacognition has an important effect on learners' writing and thinking skills (Cer, 2019; Kim, 2016; Lu, 2006; Mekala, Shabitha, & Ponmani, 2016; Yanyan, 2010; Zimmerman & Bandura, 1994). This work has shown that learners become aware of the strategies they use in writing, identify effective strategies, and adapt accordingly.

In a previous study (Colognesi & Van Nieuwenhoven, 2016), we asked metacognitive questions of 16 10- to 12-year-old students at three points during their writing activities. They were asked to write a lost-and-found notice about their childhood teddy bear. Prior to the task, students were asked to express their specific goals and explain how they were going to proceed. While they were writing, the researcher invited them to explain what they were doing (changing, deleting or adding something) and why. After the task, they had to say if they were satisfied with their work, why, and identify the strategies that were used. The result of this study showed that these moments of metacognitive activity brought an awareness of the mechanisms involved in writing. They also supported the development of planning, writing and revision skills. Results of that study has also been shown that the metacognitive mediations thus offered to students lead them to become aware of their progress. In fact, these mediations lead students to make their progress explicit and consistent. Moreover, they highlight the benefits of the learning activities implemented by the teacher or the contributions of peers.

Cer (2019) conducted a study of 44 secondary school students. His objective was to examine the effect of the metacognition on improving learners' writing skills. Students in the experimental group were trained to use writing practices based on the metacognitive strategy. This was not the case for the control group. The study found that students in the "metacognition" condition improved their writing skills. They improved on the following aspects: context, style, language and structures of expression. In addition, the pupils in the experimental group "developed strategies related to what they know and how they know it, as well as why and when they should use pieces of information, with the aid of learning about learning and thinking about thinking" (Cer, 2019, p. 13). However, the author pointed out at the end of his text that his findings suggest that further research should be conducted. He believed that a more full determination of the impact of metacognition on writing skills is needed.

This study

This study may echo other work that has analyzed the issue. But in many cases, this other work (for example Cer, 2019; Escorcia and Fenouillet, 2011) has been done with students in secondary or higher education. And those studies did not investigate a comprehensive instructional program based on effective literature-based practices for teaching writing. That is our contribution.

In our previous work (Colognesi & Lucchini, 2018a), we have already sought to show the effects of a training program that combines effective practices for teaching writing identified in recent meta-analyses (Koster et al., 2015; van Weijen & Janssen, 2018). But we considered these practices all at the same time (teacher input, peer interaction and metacognition). We did not show what metacognition contributes, in addition to the contribution of teacher input and peer interaction. In other words, what impact can the individual student alone have on their own writing process by being metacognitive? How might getting students to respond to metacognitive questions before, during, and after writing improve their writing skills, when this is done as part of an instructional approach that involves the use of effective practices for teaching writing?

To answer this question, we conducted an experiment with 43 students who were 11 to 12 years old. They were engaged in writing in a particular genre: book reviews. These pupils belonged to two classes at the same school, and for three weeks they experienced an instructional system combining identified principles of effective writing instruction (Koster et al., 2015), taught by the same teacher. They were required to rewrite their text several times (Kellogg, 2008), with the only difference being that in one class, metacognitive mediation was introduced before, during, and after learning and writing tasks, unlike in the other class.

There were two research questions:

> (1) What effects do metacognitive questions have on students' writing skills?
>
> (2) How do students respond to metacognitive questions?

Method

Sample

The sample consisted of 43 pupils, 11-12 years old, from the same school (a public school in the French-speaking community of Belgium), located in a well-off socio-cultural environment. These 43 students are divided into two classes. Students in one class were all in the metacognitive condition and those in the other class were all in the other condition. The matching of condition and class was done by drawing lots.

The non-metacognitive condition included 20 students: 7 girls and 13 boys. 19 students in this condition were native French speakers and one was of foreign origin (Romanian). The metacognitive condition included 23 students: 13 girls and 10 boys. 21 students in this condition were native French speakers, while two were of foreign origin (Moroccan and Romanian).

To obtain parental consent, a specific request was made to the parents of the two groups in the sample.

In order to ensure that students were at the same level for different elements of writing skill initially, we conducted a pre-test. Students had to write a text giving their opinion on their favorite book. Ten elements of writing skills were assessed, the same skills addressed during the instructional program (see Table 1 below; the criteria used to assess these elements are given in Table 3). The *t*-test revealed no significant differences between the two conditions. This suggests that the two groups were at a similar level before starting the experiment.

Instructional Program

The experiment was carried out during the months of January and February, 2018, and lasted four weeks. Students worked for a total of 800 minutes (16 periods of 50 minutes each) over 4 weeks.

The "itineraries" method of instruction for writing skills (Colognesi & Lucchini, 2016a, 2018a) was used. In this method, students produce several written versions of their text. They rewrite their text several times and progress from one version to the next. Interventions to support them and help them overcome obstacles are provided between these writing efforts. The following occur in alternation: teacher scaffolding (focused on the knowledge necessary for the genre in question) and feedback from peers. In addition, in this method, metacognitive questions are asked of students before, during and after the tasks. Figure 2 provides an overview of the stages the students went through. The same teacher taught in both conditions. He was trained in the method beforehand, and received all the necessary materials. The researchers met with him several times to answer his questions, and a researcher was present in the classroom during the teaching sessions, which helped to ensure fidelity of implementation of the instructional method.

In both conditions, one class period (50 minutes) was spent defining the objectives for students and explain the writing project to them. The instructions were as follows: "You are going to put yourself in the shoes of a comic book critic and share your comic book preferences with the other students. You will be asked to present your favorite comic book and give your opinion. So you're going to have to critique your favorite comic book". The students determined with the teacher the parameters of the writing situation (who is writing, for whom, under what conditions, what, why, etc.).

The students produced five versions of their text. About 50 minutes was spent on writing each time. To help students improve, they received coaching from the teacher and their peers. The teacher delivered instructional scaffolding at three points. The first took place after the first version of the text

Table 1. *Descriptive statistics and comparison of initial pre-test scores for elements of writing skills per condition*

	non-metacognitive condition *n*= 20		metacognitive condition *n*= 23		$t_{(41)}$	*p*
	M	*SD*	*M*	*SD*		
Communication intention /4	3.05	(.91)	3.04	(.48)	-.03	.515
Idea development /7	4.84	(1.95)	4.48	(1.53)	-.66	.743
Message organization /6	4.16	(1.25)	4.65	(.93)	1.41	.082
Textual consistency /6	2.95	(1.54)	2.87	(1.36)	-.17	.567
Vocabulary /6	3.26	(1.66)	3.30	(1.14)	.09	.463
Sentence construction /10	8.52	(1.95)	9.17	(1.07)	1.29	.104
Verbs /10	8.71	(1.13)	8.15	(1.40)	-1.43	.920
Adverbs	3.26	(.32)	3.30	(.29)	.09	.463
Spelling /50	47	(.56)	47.30	(.57)	.34	.366
Presentation /8	6.15	(1.01)	6.22	(.99)	.19	.424

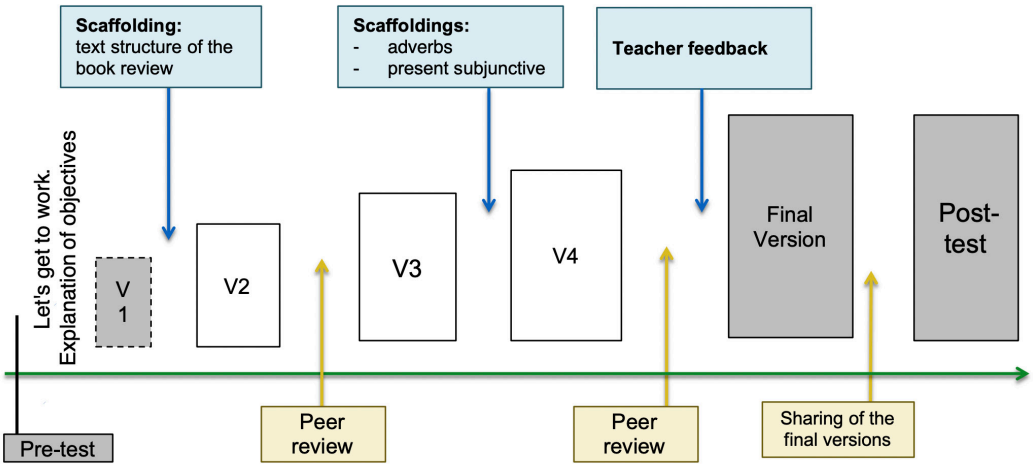

Figure 2. Schematization of the instructional program (see Colognesi & Lucchini, 2018a)

had been written (duration of teaching activity : 2 class periods of 50 minutes each). Students compared model texts to isolate the text structure of the book review. The methodology presented by Colognesi and Lucchini (2018b) was used for this instruction. The other two teaching moments took place after writing the third version of the text (4 class periods of 50 minutes each). The students worked on adverbs and on the use of the present subjective. These topics were selected because they play a major role in book reviews.

Twice, in sub-groups of four, students read the texts of another group and gave feedback to their peers. This was done after writing the second and fourth versions of the text (50 minutes each time). See Colognesi and Descehepper (2018) for details on the specific steps and effects of these collaborative review moments. After the second peer feedback event, the teacher also gave feedback. He read the students' texts and annotated them. This included using a code to allow students to correct their own work.

After writing their final version of the book review, students were able to read each other's texts (50 minutes). Finally, two weeks later, the students had to write a new text on their own. This served as a post-test (50 minutes). The instruction was to write a film review. The students had viewed the film the week before.

In the non-metacognitive condition, the students were not asked the questions associated with metacognitive mediations. However, they worked on writing at the same time as in the other class. They simply had more time to write and proofread their text with tools such as the dictionary or conjugation tables.

In the metacognitive condition, students were asked metacognitive mediation questions before, during and after the periods of writing. These were asked not only when they were required to write, but also when they were working with the teacher (on text structure, adverbs and the present subjunctive tense of verbs).

Before and after learning and writing tasks, they had to respond orally to the teacher's questioning. During the writing times, students were invited to pair up for discussions, based on questions written on the blackboard. The metacognitive mediation questions are presented in Table 2. These questions are based on the work of Authors (2016a, 2019).

Table 2. *Questions asked of students in the metacognitive condition*

Before learning and writing tasks	- Explain your understanding of the task. - What is your personal goal for this task? - How will you proceed: what steps do you think you will take? Where will you start?
After learning and writing tasks	- How did you go about completing the task? What steps did you go through? - What did you learn in this activity? - Are you satisfied with your work? - If you do the same activity again tomorrow, what strategies will you use to be more effective? What are the reasons for this?
During writing tasks	- Explain what you've done so far. What steps have you gone through? - When you encountered a difficulty, what did you do? - And now, how do you think you're going to continue writing? What are your next steps?

Methods of data collection and analysis

To answer our research questions, a mixed-method approach was used (Creswell & Plano Clark, 2007).

Measuring student progress

To observe the effects of the metacognitive mediations on students' writing outcomes, we considered three of the six texts produced by the students: the first version of the book review (V1), the last version of the book review (Final Version) and the film review (post-test). In the end, the pre-test and these three products for each student were evaluated, a total of 172 written products. Two experienced teachers did the evaluations. They worked in the same room, each one working separately on a given text. Then they discussed their evaluations, to reach an agreement on the grade to be given for each element. The criteria used for the evaluation of the written products are presented in Table 3. They were previously used in the frameworks of other studies (Authors, 2017, 2020). The different elements of writing skills relating to textual knowledge and know-how were evaluated (Dabène, 1991; Lord, 2009).

A *t*-test analysis was used to compare the mean scores of two groups on the pre-test and post-test. An analysis of variance (repeated measures ANOVA) was applied to the results obtained for V1, the final version, and the post-test. A Tukey-Kramer post-hoc test was used to compare pairs of means.

Collecting student responses to metacognitive questions. In the metacognitive condition, students' responses to metacognitive questions asked by the teacher (before and after the tasks) were audio recorded. Discussions between students were also recorded. All data were transcribed in full. A content analysis was applied to the collected data. A mixed model was used (L'Ecuyer, 1990). Thus, student responses were coded according to pre-existing and induced categories. The pre-existing categories were the elements of writing skills presented above. As the objective was to understand the progress identified in the statistical analysis, particular attention was paid to those elements of writing skills that have evolved the most. This was done in relation to student responses before, during and after the tasks. The categories that have been induced relate to the students' perception of progress and the tasks they have experienced.

Main Results

The results are presented according to the two research questions: (1) What effects do metacognitive questions have on students' writing skills? and (2) How do students respond to metacognitive questions?

What effects do metacognitive questions have on students' writing skills?

Regarding the quantitative approach it is worth mentioning that, prior to analysis, checks of the theoretical assumptions underlying analysis of variance were undertaken including normality, homogeneity of variance and independence. The report showed that the assumptions were met.

Table 4 shows the students' results by condition at the three times evaluated: the first version of their comic book review (Time 1), the final version (Time 2) and the post-test (Time 3). As a reminder, the film review (post-test) was produced a few weeks after the experiment.

There are three main aspects to note when reading the results.

Table 3. *Criteria used to evaluate elements of students' writing skills*

Element of writing skills	Criteria	Scoring
Adapt writing according to the communication situation (i.e., communication intention) /4	- compliance with the instructions - awareness of audience	A rating from 0 to 3 for the first criterion (0 = no, 1 = partial, 2 = yes, 3 = excellent); 1 point (yes) or 0 (no) for the second criterion
Idea development /7	- quality of content developed - clarity of ideas presented - effortless understanding of the whole text	A rating from 0 to 3 for the first two criteria; 1 point (yes) or 0 (no) for the third criterion[1]
Message organization /7	- title - introduction - book information - book summary - personal view - conclusion - uses paragraphs	1 point for each desired characteristic identified
Textual consistency /6	- paragraph links - anaphoric network	A rating from 0 to 3 for each criterion.
Vocabulary /6	- rich vocabulary - book review vocabulary	A rating from 0 to 3 for each criterion.
Sentence construction /10	- syntactically and semantically correct sentences	The ratio of the number of correct sentences to the total number of sentences. The result has been transformed on 10 points.
Verbs[2] / 10	- verbs agreement	The ratio of the number of properly conjugated verbs to the total number of verbs. The result has been transformed on 10 points.
Adverbs: count	number of adverbs used in the text	Counting
Spelling / 50	- misspelled words	On the first 50 words: 1 point per correct word
Presentation of the text /8	- Handwriting - overall presentation of the document (readability, care)	A rating from 0 to 4 for each criterion

[1] is awarded if the text is read in one go without having to go back over certain sentences to understand them. 0 is awarded if it is necessary to reread certain parts of the text several times in order to understand it. [2] Verbs and adverbs were each the subject of a specific criterion because these were the learning objects that were worked on during the scaffolding.

Table 4. *Repeated measures ANOVA results, descriptive statistics for observed elements of writing per condition*

	non-metacognitive condition *n*= 20									metacognitive condition *n*= 23								
	Version 1 (Time 1)		Final Version (Time 2)		Post-test (Time 3)		$F_{(58, 2)}$		HSD	Version 1 (Time 1)		Final Version (Time 2)		Post-test (Time 3)		$F_{(58, 2)}$		HSD
	M	*SD*	*M*	*SD*	*M*	*SD*				*M*	*SD*	*M*	*SD*	*M*	*SD*			
Communication intention /4	2.71	(1.04)	2.94	(1.14)	3.23	(1.09)	.36			2.86	(.94)	3.86	(.35)	3.54	(.50)	13.58	***	1-2
Idea development /7	3.24	(1.03)	4.65	(1.96)	5.11	(1.62)	4.13	*	1-2	3.86	(1.75)	5.81	(1.53)	6.00	(1.02)	14.31	***	1-2
Message organization /6	2.53	(1.12)	5.18	(1.42)	5.53	(1.00)	31.82	***	1-2	3.27	(1.07)	6.09	(.53)	6.09	(.07)	73.38	***	1-2
Textual consistency /6	.94	(.65)	1.65	(1.32)	2.52	(.75)	7.80	**	1-3	.95	(.99)	3.23	(1.79)	3.77	(1.50)	22.65	***	1-2
Vocabulary /6	2.29	(.98)	3.06	(1.34)	3.82	(.98)	3.71	*	1-3	2.72	(1.28)	4.41	(1.59)	3.95	(1.46)	13.23	***	1-2
Sentences /10	6.83	(.26)	8.04	(.17)	8.50	(.18)	2.84			6.48	(.35)	9.32	(.11)	9.20	(.12)	11.37	***	1-2
Verbs /10	7.91	(.23)	9.31	(.09)	8.12	(.17)	3.23			8.45	(.12)	9.42	(.06)	8.13	(.14)	7.74	**	1-2
Adverbs	4.41	(2.45)	5.82	(3.99)	2.11	(3.14)	6.12			2.64	(1.78)	7.91	(3.61)	5.36	(2.10)	22.74	***	1-2
Spelling /50	46.23	(3.30)	49.23	(1.09)	46.17	(4.79)	4.44	*	1-2	46.18	(3.21)	48.77	(1.69)	46.23	(3.03)	6.47	***	1-2
Presentation /8	5.59	(.93)	7.76	(.43)	7.52	(.99)	30.94	***	1-2	4.64	(2.01)	7.41	(1.22)	7.68	(.64)	31.43	***	1-2

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

First, there were some significant improvements in both classes: in idea development, message organization, textual consistency, vocabulary, spelling and text presentation. This can be traced back to the effects of the instructional method. Indeed, the support provided by the teacher and the interactions between peers allowed these improvements to take place. This has already been shown in other studies (Authors, 2017, 2018a). Moreover, for these elements, there was no significant difference between time 2 (final version) and time 3 (post-test). This means that learning was stabilized and transferred by the pupils.

For four of the significant elements in the two conditions, the post-hoc test carried out showed that the significant improvement occurred between time 1 and time 2. That is to say, the progress was between the first and final versions produced during the learning process. In both classes, therefore, the pupils therefore progressed within the planned learning time.

This was true for idea development, the organization of the message, the spelling and the presentation of the text.

For idea development, for the non-metacognitive condition, the mean was 3.24 (*SD*= 1.03) at time 1 and 4.65 (*SD*= 1.96) at time 2, $F_{(58, 2)}$= 4.13, p < .05. In the metacognitive condition, the mean was 3.86 (*SD*= 1.75) at time 1 and 5.81 (*SD*= 1.53) at time 2, $F_{(67, 2)}$= 14.31, *p*< .001. The mean of message organization for the non-metacognitive condition went from 2.53 (*SD*= 1.12) at time 1 to 5.18 (*SD*= 1.42) at time 2, $F_{(58, 2)}$= 31.82, *p*< .001. In the metacognitive condition, the mean went from 3.27 (*SD*= 1.07) at time 1 to 6.09 (*SD*= .53) at time 2, $F_{(67, 2)}$= 73.38, *p*< .001. For spelling, the average went from 46.23 (*SD*= 3.3.0) at time 1 to 49.23 (*SD*= 1.09) at time 2, $F_{(58, 2)}$= 4.44, *p*< .05 for the non-metacognitive condition. It went from 46.18 (*SD*= 3.21) at time 1 to 48.77 (SD = 1.69) at time 2, $F_{(67, 2)}$= 6.47, *p*< .001 for the metacognitive condition. And for presentation, the average went from 5.59 (*SD*= .93) at time 1 to 7.76 (*SD*= .43) at time 2, $F_{(58, 2)}$= 30.94, *p*< .001 for the non-metacognitive condition. The mean score for presentation improved from 4.64 (*SD*= 2.01) at time 1 to 7.41 (*SD*= 1.22) at time 2, $F_{(67, 2)}$= 31.43, *p*< .001 for the metacognitive condition.

A different pattern was seen over time in the two conditions for two significant elements: textual consistency and vocabulary. In the non-metacognitive condition, the significant difference in the scores for these two elements was between time 1 and time 3. Textual consistency showed a mean of .94 (*SD*= .65) at time 1 and 2.52 (*SD*= 7.80) at time 3, $F_{(58, 2)}$= 7.80, *p*< .05. For vocabulary, the average went from 2.29 (*SD*= .98) at time 1 to 3.82 (*SD*= 3.71) at time 3, $F_{(58, 2)}$= 3.71, *p*< .05. For the metacognitive condition, the significant improvements for these two elements were between times 1 and 2. For textual consistency, the mean was .95 (*SD*= .99) at time 1 to 3.23 (*SD*= 1.79) at time 2, $F_{(67, 2)}$= 22.65, *p*< .001. For vocabulary, the average went from 2.72 (*SD*= 1.28) at time 1 to 4.41 (*SD*= 1.59) at time 2, $F_{(67, 2)}$= 13.23, *p*< .001. Here again the progress was during the dedicated learning process, between the first and final version of the text. These observations lead us to conclude that in the non-metacognitive condition the students needed more time to show progress on these elements.

Secondly, in the metacognitive condition, all elements showed significant improvement. Indeed, four elements showed significant improvements that were not present in the non-metacognitive condition. This progress was significant between times 1 and 2, with no differences between times 2 and 3, which means, once again, that the learning had already occurred and was transferred by the students. Thus, for students in the metacognitive condition, mean scores for communication intention went from 2.86 (*SD*= .94) at time 1 to 3.86 (*SD*= .35) at time 2, $F_{(67, 2)}$= 13.58; p < 0.001. For sentence construction, the average went from 6.48 (*SD*= .35) at time 1 to 9.32 (*SD*= .11) at time 2, $F_{(67, 2)}$= 11.37, p < 0.005. For verbs, the student results were 8.45 (*SD*= .12) at time 1 and 9.42 (*SD*= .06) at time 2, $F_{(67, 2)}$= 7.74, p < 0.001. And for adverbs, the mean went from 2.64 (*SD*= 1.78) at time 1 to 7.91 (*SD*= 3.61) at time 2, $F_{(67, 2)}$= 22.74, p < 0.001.

Three of the four elements that showed significant improvement for students in the metacognitive condition were those that were the subject of specific time spent working with the teacher. Indeed, communication intention was worked on by answering a series of questions (who is being written to, why, etc.) and the learning and production objectives were largely reformulated. In addition, adverbs and verbs were given special support. Students were given specific activities to work on for the present subjunctive and adverbs. These two skills were necessary for the production of a book review. Moreover, these results lead us to believe that the metacognitive mediations allowed students to better consolidate their learning, and that this allowed them to better reuse that learning in their final version.

Third, the t-tests carried out to compare post-test scores (time 3) showed three elements with significant differences between conditions (see Table 5). Indeed, for textual consistency the mean score on the post-test was 2.52 (*SD*= .75) in the non-metacognitive condition and 3.77 (*SD*= 1.50) in the metacognitive condition, $t_{(41)}$= 2.92, *p*< .01. For sentence construction, the average on the post-test was 8.50 (*SD*= .18) in the non-metacognitive condition and 9.20 (*SD*= .12) in the metacognitive condition, $t_{(41)}$= 2.73, *p*< .01. And for adverbs, the score was 2.11 (*SD*= 3.14) in the non-metacognitive condition and 5.36 (*SD*= 2.10) in the metacognitive condition, $t_{(41)}$= 6.21, *p*< .001.

How do students respond to metacognitive questions?

We were interested in explaining the progress made by the students in the metacognitive condition, presented above. This guided our content analysis. Why did these students improve more in constructing correct sentences and in using adverbs? These two aspects first caught our attention because they emerged from the comparison of the two classes during the process (Times 1-2 and 3), but also from the comparison of the two groups on the post-test (Time 3). Several aspects related to the improvement for these two elements emerged from the students' responses. They are highlighted below, and illustrated by emblematic verbatim statements (all from students in the metacognitive condition).

Table 5. *Descriptive statistics and comparison of post-test scores for elements of writing skills per condition*

	non-metacognitive condition *n*= 20		metacognitive condition *n*= 23		$t_{(41)}$	*p*
	M	*SD*	*M*	*SD*		
Communication intention /4	3.23	(1.09)	3.54	(.50)	1.18	.246
Idea development /7	5.11	(1.62)	6.00	(1.02)	1.93	.061
Message organization /6	5.53	(1.00)	6.09	(.07)	1.77	.086
Textual consistency /6	2.52	(.75)	3.77	(1.50)	2.92	.006 **
Vocabulary /6	3.82	(.98)	3.95	(1.46)	.30	.762
Sentence construction /10	8.50	(.18)	9.20	(.12)	2.73	.009 **
Verbs /10	8.12	(.17)	8.13	(.14)	-1.67	.098
Adverbs	2.11	(3.14)	5.36	(2.10)	6.21	.000 ***
Spelling /50	46.17	(4.79)	46.23	(3.03)	.04	.968
Presentation /8	7.52	(.99)	7.68	(.64)	.74	.463

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

Comments related to sentence improvement and the use of adverbs appeared in many of the students' responses. First, these aspects were mentioned when students were planning. They explicitly said that they wanted to write more correct sentences. They also verbalized the fact that it is important to add adverbs (here it is important to remember that the scaffolding related to adverbs was presented between versions 3 and 4). And they justified why.

> *I'll make my sentences more precise. I will read them again and formulate them better. To make you want to read it more. (SI, before V2)*
>
> *I will try to add some more adverbs to clarify more...to give information in my review (VOL, before V4).*
>
> *I'm going to add some adverbs. It might make the text more precise. It will be more precise. More pleasant to read too. (VA, before V4)*

Secondly, when students took stock after writing, they still mentioned these aspects. They talked about their evolving text because there was more text, because the sentences were more understandable, better written. They also noted that the text was of better quality because they used adverbs. So, it seems that these aspects were used as important criteria when students evaluated their written products.

> *I wrote more things. I'm happy. My text is getting longer. I have inserted more information. (VO, after V2)*
>
> *This second version is much more spaced out. Much more beautiful. It still makes you want to read it. My sentences are easier to understand. They're better written. I had time to correct. (SI, after V3)*
>
> *I got better... we did some stuff to uh... to uh... to uh... to learn how to improve it, how to write better... with better words... uh... with lots of adverbs. (Ni, after V4)*
>
> *I've added details. And now it's better and I added more details thanks to the adverbs. (FA, after V4)*

Thirdly, these elements also appeared when students were questioned at the end of the process, when they had to explain what they would keep if they did this writing task again. The students expressed that they would be careful to construct correct and understandable sentences. They also said that they would use adverbs, justifying why. Note also that the students talked in addition about the other instructional activity, in which the text structure was worked on. This shows that the scaffolding provided by the teacher was used as a reference point when considering a new writing task. In the end, it seems that the students here used what they had been working on in the "adverb" scaffolding to answer metacognitive questions. There were also mentions of the other types of scaffolding, but they were less frequent. Thus, while many answers dealt with text structure, few related only to verbs.

> *What helped me the most was the structure and the adverbs. To do it again, I'll pay attention to the structure. By making small paragraphs and notes. I'll make sentences that you can understand. And also the adverbs, because that way it's more precise. (NI, after Final version)*
>
> *I notice that... there's... uh... there's a lot more information,... and... and... and... and uh... the texts are better written. Because we saw how to do the structure. (SU, after V2)*

Fourth, in their responses, students also referred to the advice they received. They still used the fact that it is important to write correct sentences, and that adverbs are important. They also expressed the need to add tense connectors and avoid repetition. These aspects were related to the third aspect that was significant in the post-test: textual consistency.

> *I'll rewrite it. I've been told to watch out for repetitions. I'll try. (LO, before V3)*
>
> *I have to add connectors to link the information. (FA, before V3)*

Fifth, an additional aspect to note is that students talked about the differences they saw between their versions. They expressed satisfaction with the results, and said they are proud of what they produced. They mentioned that they see what they have achieved as progress. Several examples above already showed this. These aspects are directly related to feelings of competence. This seems to be important, especially in the context of writing activities, because this awareness leads students to strengthen their relationship with writing.

> *Yes, I'm very satisfied. Since I started critiquing, it has improved a lot. I've written a lot more, and there are paragraphs. There are more ideas. I think my text is much better now (NO, after Final version).*

The students also mentioned that they had learned things. This is interesting in the sense that they made connections between what they learned and what they produced. In this way, they explained that the aspects they worked on were directly useful in the following revisions. This can be linked to motivational theories that take into account the task value that students assign (Eccles & Wiegfield, 2002).

We've learned a lot... it's helped us improve our review (FA, after Final version).

Conclusion

In this study, we wanted to see the effects of metacognitive mediations integrated into a writing instruction program. This writing instruction program incorporates the various principles of effective writing instruction: goal setting, peer support, teacher feedback and instruction in writing strategies (Koster et al., 2015; van Weijen & Janssen, 2018). We worked with two groups who went through the same learning sessions in this instructional program for four weeks. One group also participated in metacognitive mediations before, during and after the periods of writing. The other did not.

Our results show that students in both conditions made significant progress for the following elements: idea development, general organization of the text, textual consistency, vocabulary, spelling, and text presentation. We attributed these improvements to the instructional program and its effective practices.

On the other hand, in the metacognitive condition, students made more significant progress. They also made progress in the following elements: communicative intention, correct sentence construction, subject-verb agreement, and use of adverbs. On the other hand, the comparison of the post-tests of the two groups shows that in the metacognitive condition, the results were more striking. This links with the results of Graham, Harris, and Mason (2005), Escorcia and Fenouillet (2011) and Cer (2019): metacognition improved writing skills. In short, the metacognitive condition allowed students to make better progress and achieve better writing products.

An interesting aspect to note is certainly what happened with regard to adverbs for students in the metacognitive condition. This aspect improved significantly between version 1 and the final version, therefore during the instructional program. It also showed significant improvement on the post-test. The adverbs were the subject of instructional scaffolding. Metacognitive mediation would therefore have enabled the students to better anchor this knowledge, and to better see the links it could have with writing. In fact, they made extensive mention of this aspect in their metacognitive responses, whether with regard to planning their writing or evaluating it. Metacognition

would then have been used here to transfer this knowledge. Of course, this remains to be verified more widely.

Qualitative analysis of student responses also showed that students in the metacognitive condition talked about their progress. This may lead to the conclusion that they see themselves as becoming more proficient as they progress through the writing process. We had already shown this (Colognesi et al., 2019) for 11- 12-year-old students in history class who were asked to write summaries. This aspect seems to be important for the relationship that students may have with writing. This also connects with other work (Colognesi & Lucchini, 2016b; Niwese & Bazile, 2014) that has highlighted the importance of the metascriptural dimension in the relationship with the written word.

Several limitations and perspectives need to be identified. First of all, our sample is a significant limitation. Its size (43 participants) does not allow us to generalize the results. We intend to replicate this experiment on a larger scale to confirm our findings. In particular, we intend to investigate the question of the transfer of grammatical learning.

Second, we did not measure students' metacognitive knowledge and strategies. We do not know, therefore, whether these changed for students in the metacognitive condition. We have anticipated this in our next study, following the recommendations of Escorcia and Fenouillet (2011, 2018) and Jacob, Dörrenbächer and Perels (2019). Moreover, in our experiment, metacognitive activation occurred only orally. Thus, the students had to respond directly to the mediating questions without being prepared for them. However, we know that metacognition requires habit (Büchel, 2015). It seems that several questions arise here: what are the students' initial capacities to answer metacognitive questions? what would be useful interventions to help them deal with these kinds of questions? And what would be the results if the students were asked to respond in writing?

Finally, while the teacher had received training in the instructional program, he did not receive specific training in metacognition. It should be noted, however, that the majority of researcher interactions with the teacher to address questions were in this area. This reinforces the idea that teachers do not feel secure in implementing metacognition-related instruction in their classrooms (Depaepe et al., 2015; Vlassis et al., 2014). Thus, it seems, and our results encourage this, that metacognition needs to take its place in teacher education programs. Some questions then arise, such as: What knowledge and beliefs do future teachers have about metacognition? What are the factors that can help them implement metacognition-related instruction in their teaching practices? This is also an aspect that could be included in teachers' course materials. In this sense, it could help teachers to prepare their materials (Coppe et al., 2018), while including metacognition in the different moments of learning.

At the very least, the contribution of this study is to have isolated the effect of just adding metacognitive questions within an already effective instructional program. And that the time it took to do this did not hinder students from progressing as much/better than those who were able to spend all that time on working. Another interesting question is not just that they answered the questions orally, but that they discussed some of them with their peers in groups. That form of interaction could have made a difference also. This is something that remains to be investigated.

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The Impact of Mindfulness-Based Yoga Interventions on Fifth-Grade Students' Perceived Anxiety and Stress

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Abstract

With rising pressure and an increase in expected academic performance in schools across the United States, students are experiencing higher levels of stress than ever before. To address this issue, the present study examined the impact of mindfulness-based yoga interventions on fifth-grade students' perceived anxiety and stress levels through a mixed methods research approach. Quantitative data were collected from students through a pre- and post-questionnaire while qualitative data were garnered through an interview with the classroom teacher. Findings revealed that following the intervention period, students reported a slight increase in anxiety levels (1.9%) and a decrease in stress levels (9.29%). Particulrly, males in the remedial class displayed changes in both a decrease in anxiety (31.58%) and stress (16.68%) levels. Additionally, the following themes emerged from the qualitative data: (a) teacher perceptions of students' anxiety and stress in the classroom; (b) transfer of mindfulness-based yoga skills; and (c) creating a positive transition. These results suggest that mindfulness-based yoga can be a positive tool for the classroom to reduce students' anxiety and stress.

Keywords: Mindfulness-Based Yoga, Anxiety, Stress, Elementary Classroom

Introduction

The No Child Left Behind Act was signed into law in the United States in 2002 with the goal of holding schools accountable for the academic progress of all students (No Child Left Behind [NCLB], 2002). Part of the accountability plan was the inclusion of yearly mandated assessments on reading and mathematics beginning in the third grade. To increase the stakes and propel schools toward even higher academic achievement, the Race to the Top initiative was introduced in 2009. This initiative placed states against each other to compete for federal education grants, as funding was based on states' test scores. Replacing the No Child Left Behind Act, the Every Students Succeeds Act was passed in 2015 and supported the mandatory testing set forth in the No Child Left Behind Act (Every Student Succeeds Act [ESSA], 2015). These yearly assessments compelled teachers and administrators to place more emphasis on tested subjects. Subsequently, sedentary instructional time increased, while time allotted for students to participate in non-tested subjects and activities that provide more active outlets decreased (Dee & Jacob, 2010; Kohl & Cook, 2013). Due to both federal instructional mandates and increased sedentary behaviors during the school day over the past couple of decades, students have exhibited difficulties focusing on instructional tasks in the classroom, which has hindered their abilities to perform academically (Reilly et al., 2012). A lack of effective intervention strategies to assist students with attentiveness during instruction is compounded by the extensive amount of stress and pressure students experience to perform well (Hagen & Nayar, 2014). Although academic expectations have risen considerably, very few adopted and consistent interventions or programs are available for students to reset their brains and bodies during classroom instruction in order to manage rising pressures.

One approach to increasing attention in the classroom that has steadily gained momentum over the past decade is the practice of mindfulness. While mindfulness is an emerging trend for classroom teachers, a deficiency still remains in the literature regarding effective mindfulness practices in the elementary classroom. Moreover, even less research exists on effective mindfulness-based yoga interventions for the classroom.

Mindfulness

Definitions of mindfulness vary by practice or researcher, but a consistent theme in all definitions is the intentional focus and awareness on one's present environment. Researchers at The University of California Berkeley noted that it includes a non-judgmental thought process with the knowledge that there is no correct way to think or feel in any given moment ("What is Mindfulness," n.d., para. 2). The word "mindfulness" is a translation of the Sanskrit word "smrti," meaning remembering and recollecting, particularly remembering the teachings of Dhamma (Sharf, 2015, p. 473). It is an internal practice rooted in Buddhist meditation and is often seen in yoga and tai chi. Sharf (2015) stated that early Buddhist beliefs expressed a need for suffering in life; in order to relieve this suffering, one must escape this world. Mindfulness was practiced to abandon the good and happiness of the world in order to cultivate that suffering. However, the evolution of these beliefs has progressed towards a stronger focus on happiness. Mindfulness practices are now considered a therapeutic release in search of peace and fulfillment (Sharf, 2015). Furthermore, the practice of mindfulness has become more common in Western culture and recent studies reveal the emotional, social, and physical benefits that arise when students practice mindfulness (Ager et al., 2015).

Mindfulness in the Classroom and School Setting

As studies centered on exploring the benefits of mindfulness in adults become more prevalent, researchers have turned their attention to students in the school setting. Similar to adults, mindfulness can benefit all aspects of students' lives. Even though many believe that the classroom is only meant

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for academia, students' developmental domains must be met before they can focus on learning (Lund, 2010). Implementing mindfulness-based interventions into the classroom and school setting has the potential to address all of these domains. Examples of mindfulness school-based programs that have emerged over the past decade to address students' needs are the Master Mind Program (Parker et al., 2014), Mindful Schools (Mindful Schools, 2007), and Open Circle Program (Open Circle, n.d.b.). Additionally, applications such as Calm (Calm.com Inc, 2020) and Headspace (Headspace Inc., 2020) are available for parents or teachers to download directly onto their phone.

Effects of Mindfulness on Self-Regulation

The practice of mindfulness fosters thoughtful responses rather than immediate actions, which can improve reactions to the daily obstacles and stressors students encounter at school (Parker et al., 2014; Pepping et al., 2013). Moreover, when students utilize mindfulness strategies, they can improve their self-control and self-regulation, directing them away from poor decisions (Parker et al., 2014). Mindfulness can also be cultivated through the practice of yoga, which adds a physical element to mindfulness practices. Students often struggle with monitoring their reactions and decisions, but practicing yoga can foster students' ability to self-regulate their emotions and stressors by enabling them to take a step back to focus and understand what is going on around them prior to reacting (Razza et al., 2013). Ultimately, students become more aware of their thoughts and emotions, and utilize that awareness to respond positively to various situations (Parker et al., 2014).

One study analyzed mindfulness-based interventions on self-regulation in an urban classroom of 29 preschool students — 16 students were in the intervention group and 13 students were in the control group (Razza et al., 2013). A pre- and post-test measured students' self-regulation and was completed by both parents and students. Following the pre-test, the intervention group received yoga instruction in their classroom, while the control group did not receive yoga instruction. Post hoc, both groups were given a series of tests that observed their attention, delay of gratification, and inhibitory control. Results indicated that the students who received yoga instruction exhibited increased attention and inhibitory control (Razza et al., 2013). These findings reveal the vital impact mindfulness-based yoga can have on self-regulation, as it helps students remain calm, alert, and focused on the task at hand (Blair & Razza, 2007).

Effects of Mindfulness on Anxiety

Stress also can negatively affect students at school. Particularly, students experience increased stress during test-taking situations (Jones et al., 1999; Jones & Egley, 2004). Carsley et al. (2015) examined students' anxiety prior to a spelling test. Participants were 152 fourth, fifth, and sixth-grade students. Half of the students completed a mindful activity before their spelling test, while the remaining half participated in a free draw activity before their spelling test. Findings revealed that both the mindful coloring activity (p= .006) and the free draw group (p= .007) experienced a significant decrease in anxiety.

In another study, 25 students utilized mindfulness-based cognitive therapy (Semple, 2010). Participants were between nine and thirteen years of age and were enrolled in a reading program for remedial students. Throughout the study, the students practiced seated breathing techniques and body meditations. They also practiced bringing mindful attention to their thoughts and emotions. Students who initially showed high levels of anxiety at the beginning of the study showed a significant reduction in anxiety levels and negative behaviors at the end of the study (p= .02; d= .38).

Another study examined how students felt about the implementation of Meditation Capsules: A Mindfulness Program for Children (Ager et al., 2015). The students kept reflective journals throughout the duration of the study where they were asked to describe their thoughts and feelings about the mindfulness sessions, draw pictures that represented their feelings, illustrate their favorite parts of the mindfulness program, or describe when the use of mindfulness could be helpful. Findings revealed that mindfulness improved the overall well-being of students because they were more aware of their feelings. It was also noted that students were able to self-assess when they needed to utilize guided breathing and mindfulness which helped them manage their anxiety and stress (Ager et al., 2015).

Effects of Mindfulness on Stress

As expectations for academic achievement and standardized testing performance rise, many students also experience an increased amount of stress (Hagen & Nayar, 2014). Stueck and Gloeckner (2007) addressed this issue by conducting a study that examined the emotional well-being of 48 fifth-grade students who participated in yoga classes. Students began each class with a period of relaxation where they focused on being mindful of their body, followed by a session of yoga. Throughout the study, students learned 23 different yoga exercises. The end of class focused on the students' social well-being as students were partnered together to complete trust exercises and sensory games. Results indicated that students reported a decrease in feelings of helplessness, stress, and aggression. The students also showed more positive behaviors in the classroom and an increased control over emotions after the implementation of yoga (Stueck & Gloeckner, 2007). Similarly, Mendelson et al. (2010) examined the stress and mental health of fourth and fifth-grade students. Students were introduced to yoga-based physical activity, breathing techniques, and guided mindfulness practices over a 12-week period. Findings from the study's questionnaire indicated a positive impact on stress levels. One participant claimed that the program helped her learn different strategies to use at home to help lower stress levels, while another participant noted that the program helped him learn to cope with stress in a healthier way (Mendelson et al., 2010).

Physical Benefits of Mindfulness-Based Yoga

The physical benefits of yoga in the literature is predominantly focused on adults; however, the practice of yoga may also be helpful for students' body awareness and brain development. Broderick and Metz (2009) conducted a study in a Catholic, all-girls school which revealed the benefits of mindfulness in the classroom through a series of interviews and pre- and post-tests. The central foci of the study was on body awareness, understanding one's feelings, thoughts, and bodily sensations. Participants reported considerable reductions in tiredness and stated that they felt a decrease of general aches throughout their body (Broderick & Metz, 2009).

Studies have also shown significant gains in motor development for students through yoga programs (Donahoe-Fillmore & Grant, 2019; Folleto at al., 2016). Folleto et al. (2016) conducted a study that examined 16 first-graders' balance, strength, and flexibility. Student participants completed a 12-week intervention that consisted of two 45-minute yoga sessions a week. A motor proficiency test was administered to determine any changes in students' motor abilities. Following the interventions, students showed positive changes in balance, strength, and flexibility. A similar study conducted by Donahoe-Fillmore and Grant (2019) examined the balance, strength, coordination, and flexibility of 26 students, ages 10-12. Students participated in 40-minute yoga classes one to three times a week for eight weeks. A motor proficiency test was employed to measure any changes. Findings showed sta-

tistically significant changes in balance (p= .06) and flexibility (popliteal angle right, p= .005; popliteal angle left, p= .01); however, there was no significant change in strength.

Cognitive Benefits of Mindfulness

It has been noted that those who practice mindfulness have "measurably thicker brains" (Hanson, 2011, para. 15) in the insula region, the frontal region of the prefrontal cortex, and the somatosensory cortex. Providing evidence to these claims, Hanson (2011) conducted a cohort study to compare the brain thickness of those who practiced mindfulness meditation and those who did not. Participants who did not practice mindfulness experienced thinning of the brain, or cortical thinning, which is typical with aging. Results also indicated that participants who did practice mindfulness did not experience cortical thinning. Conversely, their brain remained the same thickness even as they aged (Hanson, 2011).

A systematic review of nineteen studies on the cognitive benefits of mindfulness evaluated 1,348 students in first through twelfth grade. Results indicated the cognitive performance between groups was statistically significant (p< .05) (Zenner et al., 2014). Another study focused on the relationship between mindfulness and assessment scores (Bellinger et al., 2015). Participants were undergraduate students who were asked to listen to recordings of mindful breathing exercises and complete a questionnaire which examined their anxiety and mindfulness. At the conclusion of the recordings and questionnaires, participants completed a set of math problems. Findings revealed that participants completed the problems with more accuracy following the intervention because of a decrease in test anxiety. Another study analyzed selective attention and test anxiety. First, second, and third-grade students participated in a 24-week Attentive Academy Program which was designed to improve their life through the practice of mindfulness (Napoli et al., 2005). Students completed pre- and post-measures including a Test Anxiety Scale and Test of Everyday Attention for Children subtests. At the conclusion of the program, a statistically significant change in both selective attention (p= .001) and test anxiety (p= .007) was revealed, thus showing the possible benefits of mindfulness within schools (Napoli et al., 2005).

Benefits for Classroom Teachers

Teachers also face high levels of anxiety and stress in their daily lives, which can affect the classroom environment (Herman et al., 2017). One study revealed that some teachers struggle managing stress related to students who lack motivation, student discipline, workload, constant changes, evaluations, administration, self-esteem, and poor work conditions (Kyriacou, 2001). A teacher's attitude and behavior can even affect students' learning and the quality of the overall classroom. Studies have revealed that students in classrooms with positive teacher-student relationships are more engaged and perform better in school (Eccles & Roeser, 2004; Holas & Huston, 2012). Therefore, interventions that address the anxiety and stress of both students and teachers could be deemed highly instrumental in classroom success. For example, a special education supervisor in Pennsylvania stated that before her middle school implemented yoga there was a much higher teacher turnover rate. Since the implementation of yoga, the turnover rate has decreased dramatically (Garey, n.d.). With hyperactive and restless students, teacher attrition was an issue, until mindfulness was introduced into the school's classrooms. The students began practicing awareness of the "attention to breath, how different parts of their bodies feel, how their feet connect to the floor, their seats to their chairs, and… the present moment" (Garey, n.d., para. 4). Through these practices, students became calmer and more capable of self-regulating, making their education and their teachers' work more enjoyable and effective.

Current Mindfulness-Based Programs

Considering the well-established benefits of practicing mindfulness, schools have begun to adapt mindfulness-based programs. Several programs have been developed in an effort to implement mindfulness practices into classrooms across the United States. One program, Open Circle, was created for kindergarten through fifth-grade. The curriculum encompasses five topics — beginning together, managing ourselves, strengthening relationships, how to sort problems, and problem solving (Open Circle, n.d.a). Mindfulness is found throughout the curriculum within activities such as "calm breathing techniques, pause button, partner reflections, chair yoga, 3-minute breathing space, walking meditation, and what color are your feelings?" (Open Circle, n.d.c). Open Circle believes that "mindfulness is a key support for optimal learning" (Open Circle, n.d.c, para 1). Hennessey (2006) examined the benefits of the Open Circle Program on eight fourth-grade classrooms across four different schools. After utilizing Open Circle for an academic year, teachers reported significant changes in social skills (p= .001) and problem behaviors (p= .001), particularly for students in urban schools.

Another program, Mindful Schools, focuses on "under-resourced public schools facing high turnover rates and toxic stress" (Mindful Schools, 2007, para. 1). This program provides a curriculum that is easily implemented into the school day. The overarching goal of Mindful Schools is for teachers to understand the emotions and stress that students in today's society increasingly experience. Therefore, courses are offered for teachers that equip them with the ability to utilize mindfulness-based interventions to work with students on these issues. An evaluation of the Mindful Schools program revealed that 89% of students have shown "improved emotional regulation" (Mindful Schools, 2007, Impact section).

Calm Schools took a different approach and rather than writing curriculum, created an application that can be downloaded onto a phone or computer and utilized in the classroom (Calm.com Inc., 2020). The application is free to teachers across the world and provides them with the necessary resources to engage students in calming activities. Breathing exercises, calming music, and guided meditation sessions with a focus on topics such as anxiety, stress, self-esteem, and happiness are all components of this application. There is also a "Daily Calm" feature to get the day started in a peaceful and calm manner (Calm.com Inc., 2020).

Another application, Headspace, was initially created with businessmen in mind. However, further development allowed everyone access to mindful practices (Headspace, 2010). The application consists of guided meditation exercises for work, children, sleep, focus, stress, and anxiety. Meditation is geared towards children and includes themed exercises to help them focus, be kind, calm down, go to sleep, and wake up. These exercises are further grouped for different age groups including under five-years-old, six to eight-years-old, and nine to twelve-years-old.

The Momentous School, founded in 1997, has monitored students for more than twenty years by tracking their progression through mindfulness-based education (Kinder, 2017). The school is focused on protecting students from the harmful stress of today's society. They use mindfulness to teach students to focus on "regulating their nervous system" and to "manage their internal world regardless of what comes at them externally" (Kinder, 2017, para. 7).

A two-year study was conducted at the Momentous School which compared students who received mindfulness-based interventions with those who received an education without mindfulness. This study had a particular focus on academic achievement, as students were followed from pre-kindergarten to kindergarten (Thierry et al., 2016). After completing pre-kindergarten, students who received mindfulness training "showed improvements in teacher-reported executive function skills, specifically related to working memory and planning and organizing, whereas students in the control group showed a decline in these areas" (Thierry et al., 2016, p. 2). Students were followed into kindergarten and results indicated that by the end of the year the students who had practiced mindfulness had increased vocabulary skills compared to students in the control group.

Purpose of the Study

There is an increasing trend in the literature examining the impact of mindfulness-based interventions and programs for elementary-aged students. However, minimal studies have focused on the impact that mindfulness-based yoga interventions may have on the well-being of elementary school students, and how classroom teachers perceive this practice. Therefore, the purpose of this study was to examine the impact of mindfulness-based yoga on fifth-grade students' perceived anxiety and stress and to garner the teacher's perceptions of the intervention. The following research questions guided this study:

1. How do mindfulness-based yoga interventions impact fifth-grade students' perceived anxiety and stress levels in a mathematics classroom?

2. What is a fifth-grade classroom teacher's perceptions of mindfulness-based yoga interventions?

Methods

The present study took place in three fifth-grade mathematics classes at an intermediate school in Northwest Mississippi for three months during Fall 2018. After approval was received from the University's Institutional Review Board, written consent was obtained from a fifth-grade mathematics teacher. Participants were fifth-grade students in the teacher's classes; therefore, a convenience sample was utilized. The researchers communicated through the consent letter sent home that each student must complete the intervention as a part of their classroom activity; however, if they chose not to obtain consent or provide assent, students did not complete the pre- or post-questionnaire. Fifty-eight students (76%), among three classes, ranging from ages 10-12 chose to participate with parental consent and student assent. Demographics of the participants were White (72.41%), African-American (20.69%), Hispanic (3.45%), and Asian (3.45%). Participants in the first class consisted of seven males and five females. The second class consisted of eight male and thirteen female participants. The third class consisted of twelve male and thirteen female participants. In total, there were 27 male participants (46.55%) and 31 female participants (53.45%).

Participants were separated into classes based on ability level. Each student's level was determined by his/her state test scores from the previous year. The first class consisted of students with the lowest scores, with the exception of students with an Individualized Education Program — 12 of these students participated in the study (57.14%). Additionally, one student participant in the first class was on Tier 3 remediation for mathematics and English, while another student participant was on Tier 2 remediation for mathematics and Tier 3 remediation for English and behavioral interventions. The second class consisted of students in the average range —21of these students participated in the study (77.78%); there were no students in the tier process. The third and final class consisted of advanced students —25 of these students participated in the study (89.29%). One student participant in this class was on Tier 3 remediation for behavioral interventions.

Procedures

Design

This study utilized both quantitative and qualitative measures to collect data regarding the impact of mindfulness-based yoga interventions on the perceived anxiety and stress of students in three fifth-grade mathematics classrooms. Thus, a concurrent mixed methods design was used (Creswell et al., 2003), as the qualitative data were utilized to supplement the quantitative findings. Quantitative data were collected first through a pre-questionnaire. The interventions were then conducted and the study concluded with a post-questionnaire survey and classroom teacher interview.

The intervention phase of the study began on Monday, November 5th, 2018, after baseline data were collected for three weeks. A student teacher conducted all of the mindfulness-based yoga interventions at the beginning of every class period for five minutes — 7:35- 7:40 a.m.,11:32-11:37 a.m., and 1:07- 1:12 p.m. The interventions were a series of guided breathing exercises and stretches that brought students' attention to their breath and helped them relax before the class began (See Appendix A). During each breathing exercise, the student teacher gave students a few seconds to quietly find a comfortable personal space. They had the option to remain at their desk, stand up, sit on the floor, or lay down. Once in their space, for example, a counted breathing exercise was completed. Students were given a designated number of counts to breathe in and out. They could either close their eyes or let them remain open. The exercise began by breathing in and slowly counting up to the designated number while the students followed along silently. Students then released their breath and exhaled out as the student teacher counted down from the designated number. Following the breathing exercises, students completed light yoga stretches such as downward dog, butterfly pose, and tree pose while light music played in the background. The Headspace application was also utilized throughout the intervention which provided the students with a period of guided meditation (See Figure 1).

Figure 1. Students completing a mindful breathing exercise in their own space

At the conclusion of the intervention phase of the study, the

students completed a post-intervention questionnaire. The questionnaire was anonymous and identical to the pre-questionnaire. Students placed their answers in an envelope so that they could not be identified. At the conclusion of the study the resercher also interviewed the classroom teacher which enabled the researchers to obtain further insight into the classroom teacher's perceptions of the intervention.

Data Collection

Questionnaire

The questionnaire utilized during this study was adapted from the School Experience Survey created by the Community and Youth Collaborative Institute at Ohio State University (Anderson-Butcher et al., 2016) (See Appendix B). Participants completed this questionnaire at the beginning of the study and again at the conclusion of the study. The questionnaire was anonymous and consisted of thirty-two questions regarding academic motivation, school connectedness, academic pressure, college and career readiness, internalizing behaviors, on-task behaviors, and student demographics. For the purpose of this study, the researchers only utilized for interpretation the statements on the questionnaire within the factors of internalizing behaviors, on-task behaviors, and student demographics. For each of the statements, students were asked to circle one of four options - " 4 - YES!", "3 - Yes", "2 - No", or "1 - NO!" according to how much they agreed or disagreed with the statement. Validity of the School Experience Survey was determined through a confirmatory factorial analysis utilizing maximum likelihood estimation. The factor variance was estimated and no covariances between uniquenesses were modeled. An asymptotic covariance matrix was utilized and the overall fit of the model to the data revealed a good fit, wherein the squared multiple correlations averaged .44 and the confirmatory factor analysis loadings for the questions utilized within this study ranged from .53-.75 (Anderson-Butcher et al., 2016).

Semi-Structured Interview

At the conclusion of the study, the primary researcher conducted a semi-structured interview with the classroom teacher. The interview took place in the teacher's classroom at the end of the school day and consisted of questions that guided the discussion (See Appendix C). Interview questions derived from the study's research questions illuminated quantitative survey data findings regarding the effect of the interventions on students' perceived anxiety and stress. The researcher utilized unscripted follow up questions to clarify any thoughts or misunderstandings and further probe the research topic.

Data Analysis

The researchers analyzed the questionnaire results by placing results for each question into a spreadsheet and then calculating the average change from the pre-intervention questionnaire to the post-intervention questionnaire. For every "YES!" the researchers recorded a four, for every "Yes" the researchers recorded a three, for every "No" the researchers recorded a two, and for every "NO!" the reserchers recorded a one. Next, the researchers derived the numerical average (mean) for answers within the following categories: (a) all classes; (b) individual class; (c) male students by individual class; (d) female students by individual class; (e) each male student; (f) each female student; (g) each student with attention deficit hyperactivity disorder; and (h) each student without attention deficit hyperactivity disorder. The researchers then placed results for each category into bar graphs to display the findings. The overall results were compared between the pre- and post-intervention questionnaire. Lastly, the researchers compared the pre- and post-questionnaire averages to determine the percentage change and the averages were compared across the three classes, females to males, and students diagnosed with attention deficit hyperactivity disorder to those not diagnosed with attention deficit hyperactivity disorder.

The primary researcher audio recorded and transcribed the interview with the classroom teacher. Transcripts were analyzed through a coding process to identify any discernible patterns between the interview and students' questionnaire results. This coding process entailed the unitization of data into sizable chunks that were placed into a spreadsheet (Lincoln & Guba, 1985). Both researchers employed the constant comparison method (Lincoln & Guba, 1985) after coding occurred and patterns were used to determine what might cause students' perceived anxiety and stress to elevate during certain times of the day. Excerpts from the findings are provided in the results section below and examples of each theme are identified.

Results

Overall findings of the students' pre- and post-questionnaire indicated that on average, students' perceived a slight increase in anxiety and a perceived decrease in their stress levels. Across all three classes, students reported an average increase of 1.9% in perceived anxiety levels and an average decrease of 9.29% in perceived stress levels in response to the questionnaire.

Results by Gender

All male participants across the three classes reported an average decrease of 2.22% in perceived anxiety levels (See Figure 2) and an average decrease of 20.63% in perceived stress levels (See Figure 3). All females across the three classes reported an average increase of 5% in perceived anxiety levels and no change in perceived stress levels.

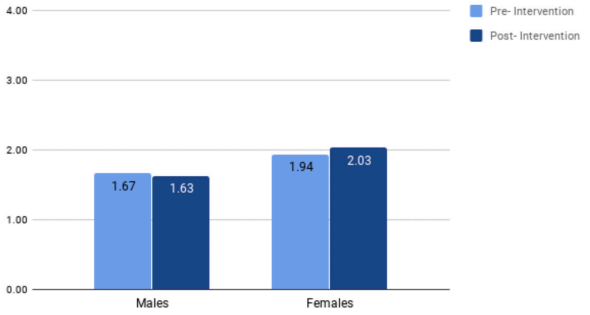

Figure 2. Overall Perceived Anxiety Level of Students

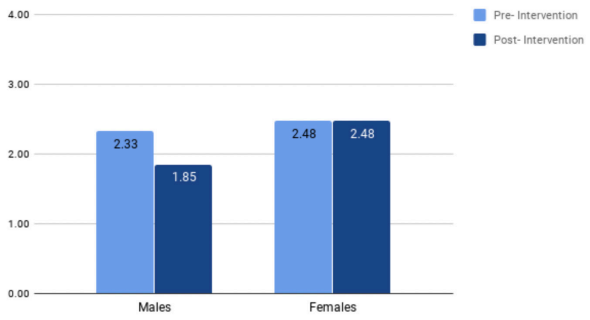

Figure 3. Overall Perceived Stress Level of Students

Results by Ability Level and Gender

In the first class, males reported a decrease of 16.67% in perceived anxiety levels and an average decrease of 31.58%

in perceived stress levels, while females in the same class reported an average decrease of 9.09% in perceived anxiety levels and an average increase of 7.69% in perceived stress levels (See Figures 4 and 5).

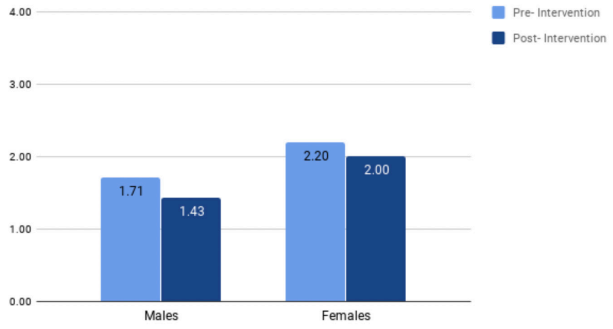

Figure 4. Perceived Anxiety Levels of Remedial Students

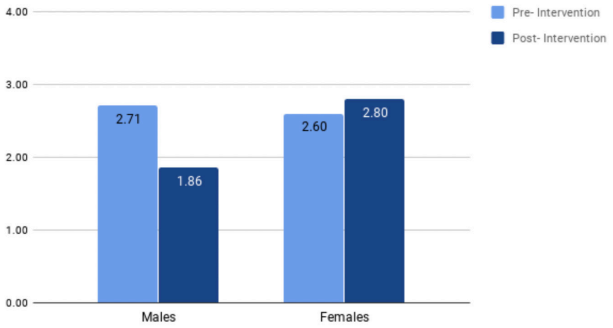

Figure 5. Perceived Stress Levels of Remedial Students

The second class consisted of average level students. Males in this class reported an average increase of 9.09% in perceived anxiety levels and an average decrease of 25% in perceived stress levels, while the females in the same class reported no change in perceived anxiety levels or stress levels (See Figures 6 and 7).

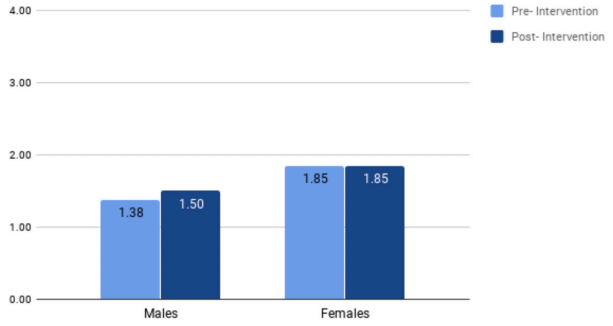

Figure 6. Perceived Anxiety Levels of Average Students

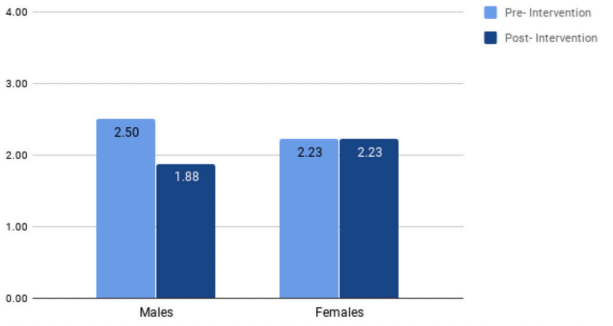

Figure 7. Perceived Stress Levels of Average Students

The third class, comprised of advanced students, reported an average decrease of 8.33% in perceived anxiety levels in male students and no change in perceived stress levels, while the females in the same class reported an average decrease of 2.86% in perceived anxiety levels and an average increase of 16% in perceived stress levels (See Figures 8 and 9).

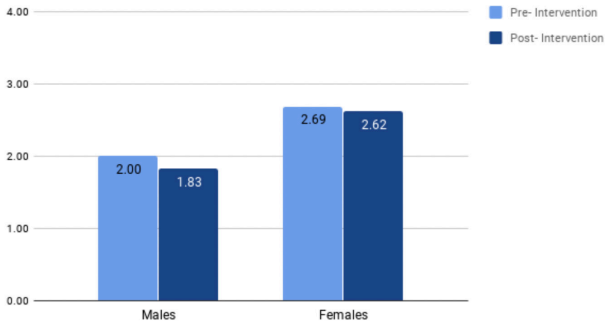

Figure 8. Perceived Anxiety Levels of Advanced Students

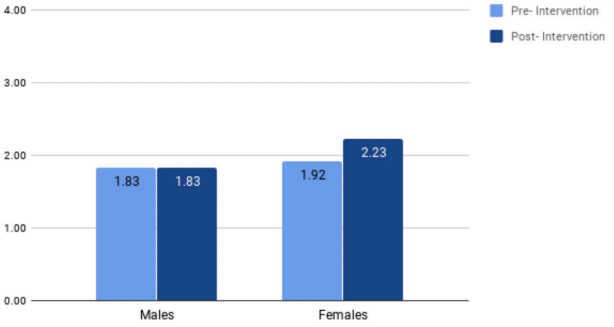

Figure 9. Perceived Stress Levels of Advanced Students

Results on Anxiety and Stress for Students with Attention Deficit Hyperactivity Disorder

Overall, the five students who stated that they had been diagnosed with attention deficit hyperactivity disorder, reported an average decrease of 22.08% in perceived anxiety levels and an average increase of 3.9% in perceived stress levels. The remaining students not diagnosed with attention deficit hyperactivity disorder reported an average increase of 5.03% in perceived anxiety levels and an average decrease of 10.58% in perceived stress levels. The students diagnosed with attention deficit hyperactivity disorder in the first class reported an average decrease of 14.29% in perceived anxiety levels and an average increase of 33.33% in perceived stress levels. The students diagnosed with attention deficity hyperactivity disorder in the second class reported an average decrease of 16.67% in perceived anxiety levels and an average decrease of 6.67% in perceived stress levels. The third class had no data to report.

Class Results on Anxiety and Stress by Ability Level

Students in the first class consisted of remedial students and students with an Individualized Education Program. Results for this class indicated an average decrease of 13.04% in perceived anxiety levels and an average decrease of 15.6% in perceived stress levels. Students in the second class consisted of average students. Findings from this class revealed an average increase of 2.86% in perceived anxiety levels and an average decrease of 10.2% in perceived stress levels. Students in the third class consisted of advanced students. Reports noted an average increase of 8.51% in perceived anxiety levels and an average decrease of 5.08% in perceived stress levels was reported for this class (See Figures 10 and 11).

Interview

In addition to the quantitative data collected, the primary

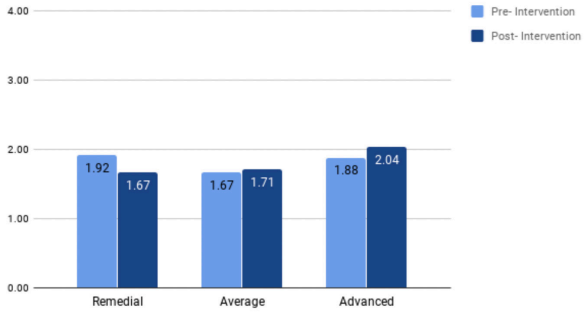

Figure 10. Perceived Anxiety Levels of Students by Ability Level

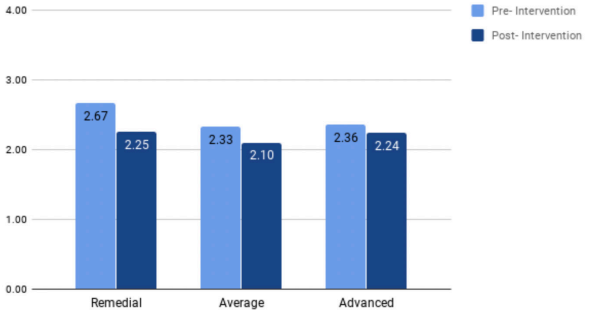

Figure 11. Perceived Stress Levels of Students by Ability Level

researcher also garnered qualitative data regarding the classroom teacher's perceptions of the impact of the mindfulness-based yoga intervention. While the quantitative findings revealed that some of the students felt a change in their anxiety and stress levels throughout the intervention, the teacher's interview provided further insight and illuminated some points that may not have emerged in the quantitative data. Three themes emerged from the interview data: (a) teacher perceptions of students' anxiety and stress in the classroom; (b) transfer of mindfulness-based yoga skills; and (c) creating a positive transition.

Teacher Perceptions of Students' Anxiety and Stress in the Classroom

Most teachers develop perceptions of their students' behaviors based on daily anecdotal observations. In alignment with the literature regarding an increase in students' anxiety and stress levels due to increased academic expectations, the teacher noted several times throughout the interview that the students consistently "exhibited behaviors that were indicative of anxiety and stress." It is important to keep in mind that students will bring stressors from home with them to school. Subsequently, behaviors that manifest at school may also be due to external factors. However, when the teacher was asked about her perceptions of the students' stress levels regarding school work and standardized testing, the teacher noted the following: "I would say the majority of them are stressed, but I'm sure 10 percent are going to stress and have anxiety no matter what." When analyzing interventions that aim to reduce anxiety and stress in the classroom it is important to keep in mind the social and home variables that play a role in the stress levels of children. Nevertheless, the teacher noted that students had made anecdotal comments to her and "expressed" how much the mindfulness-based yoga interventions had helped them "deal with anxiety and stress in general."

The teacher's thoughts regarding her perception that a majority of students have anxiety and stress anyway is important to take into consideration when developing a plan to mitigate what students encounter on a daily basis. It might be just a quick two to five-minute mindfulness transition that a teacher incorporates into the classroom if the perception and observations of one's students' indicates somewhat low levels of anxiety and stress. However, a classroom full of students exhibiting higher levels of troubling behaviors due to high levels of anxiety and stress may necessitate more intensive interventions or multiple mindfulness-based yoga sessions throughout the day. When interviewed, the following anecdote was expressed by the teacher about her perceptions of students' anxiety and stress in the classroom and how she would proceed forward with mindfulness-based yoga interventions:

> *I might do it everyday, but I might go down to not just the Headspace where the guy is talking, but instead use the music and just kind of mix it up. It would definitely be more of a mindful thing. You know, just based on what I have seen and observed. (Classroom Teacher – Fifth-Grade)*

Transfer of Mindfulness-Based Yoga Skills

With any new method, intervention, or strategy that is employed in the classroom, it is important to ensure that it is effective and transferrable. One way to determine effectiveness is to assess students' abilities to apply it in a new setting or context. Throughout the interview the classroom teacher indicated that students employed the mindfulness-based yoga strategies even when the student teacher was not there. Additionally, the classroom teacher chose to employ and adapt some of the methods that the student teacher had utilized during the study. During the interview, the teacher also noted that the students mentioned they were "using mindful breathing outside of class to manage anxiety and stress and to help them go to sleep and stop racing thoughts." This anecdote indicates that the students were applying the use of breathing techniques as a mechanism beyond the classroom to help reduce their anxiety and stress. The classroom teacher was also emphatic that some of the most positive changes occurred on "test taking days" as noted below:

> *…definitely in test taking. I think even some of them will come in on test days, but some of the girls for sure will come in and they are like 'okay let me find my headspace for a minute. Let me chill out. You know I am about to take a test, because they do have a lot of test anxiety and they just take a moment to breathe and then I will actually play some of the meditation music in the background to kind of go along with everything you have been doing because I have seen how much it helps and it just kind of eases them right through it. (Classroom Teacher – Fifth-Grade)*

In addition to utilizing mindful breathing techniques before tests in the intervention classroom, the classroom teacher indicated that the students mentioned they were "using mindful breathing before tests in other classes as well." The teacher noted that she always "notes a change in the stress and anxiety levels of students around test days." However, from the beginning of the intervention to the end of the intervention, the teacher stated that "the stress and anxiety seemed to lessen as students progressively participated in the interventions."

Creating a Positive Transition

Although the sole purpose of the mindfulness-based yoga intervention was not to examine its impact on factors beyond student-related anxiety and stress, an unexpected theme arose in the teacher interview. This outcome encompassed the ability of mindfulness-based yoga to act as a tool to facilitate effective classroom transitions. Most of the research on mindfulness in the classroom reveals the positive physical, academic, and health benefits that occur as a result of implementation but lacks the connection to how that may impact the instructional process. Because transitions are one of the most critical facets of effective instruction, it is important to note how it emerged in the teacher interview.

The transition times between the mindfulness-based yoga interventions and when students began working were not measured quantitatively. However, the teacher noted, "I think it helps them transition in a more positive way, but quicker because you have to take the time to do that. So, I don't know if it is faster, but I think it is definitely more of a positive transition."

When students enter fifth-grade in the United States, they are usually exposed to a new system of academic work. Educators expect students to move from acquiring all academic subjects in one classroom during their lower elementary school years to traversing multiple classrooms throughout the day that are compartmentalized into subjects in the upper elementary school. Within this new system, students must transition and self-regulate rapidly into multiple environments throughout the school day. Students have to learn this skill and as the teacher mentioned, "students struggle going from class to class, in the hallways, coming in, settling down. It is definitely a struggle." This struggle stems from students' inability to adapt from moving into an academic setting to a social setting and then back into an academic setting. When answering how the teacher saw the mindfulness-based yoga interventions as helpful for students, she noted: "It has helped because my students know that they are coming in to do the mindfulness. They come in, calm down, and it prepares them to move forward." This calm is the self-regulation that occurs when students are offered the opportunity to breathe and through their breath they become aware of the present moment by focusing on what they need to do with their body and mind to move forward to the next task. When probed further about the transformation the teacher had witnessed regarding the transition from hallway to student work, she noted that it has "majorly improved." While "majorly" is not quantifiable, it is important to note that because of the positive connection to the mindfulness strategies for students, they "like it," which the teacher then noted, "I like that they like it." The teacher revealed that she plans to continue using some of the mindfulness-based yoga strategies because of the positive difference and transformation she has seen it make in her classroom.

Discussion

The present study examined the impact of mindfulness-based yoga on students perceived anxiety and stress levels. In congruence with previous research (Ager et al., 2015; Folletto et al., 2016; Semple, 2010; Stueck & Gloeckner, 2007;), it could be posited that results of this study support the claim that mindfulness-based yoga interventions in the classroom can improve students' perceived anxiety and stress levels and improve overall classroom effectiveness.

Although the most impactful results emerged from students in the remedial class, the results revealed varying effects on each group. Male participants reported the greatest benefits, with a slight decrease in perceived anxiety and a large decrease in perceived stress. In particular, males in the remedial class reported the greatest changes, with the highest percentage decrease in perceived anxiety and the second highest decrease in stress. Similarly, Parker et al. (2014) found that males benefited most from mindfulness interventions in regards to their self-control. In further alignment with previous research (Parker et al., 2014), females in the remedial class reported an average decrease in perceived anxiety levels. This study's results are also in alignment with previous research (Semple, 2010) which revealed that mindfulness-based cognitive therapy may be beneficial for remedial students' perceived anxiety levels.

Findings from the classroom teacher's interview further support the notion that there was an "obvious" decrease in anxiety and stress, "especially around test days." In agreement with the teacher's corroboration of the quantitative findings, Carsley et al. (2015) reported an overall improvement in students' test anxiety when mindfulness-based yoga interventions were employed within the classroom. However, it is important to take into consideration that according to the questionnaire responses not every student reported the same positive results throughout the present study. In regards to students' anxiety levels, the questionnaire revealed that both the average and advanced level students indicated a slight rise in perceived anxiety levels between the pre- and post-intervention questionnaire. The females in these two classes also reported a rise in their perceived anxiety levels. This may have been a result of a lack of prior knowledge regarding yoga and mindfulness, a change in stressors, distractions, or academic content between the pre- and post-intervention questionnaire. In contrast to these students' responses, the classroom teacher noticed a general change in all of her classes throughout the intervention. The teacher's observations were that overall, students' anxiety had improved since beginning the intervention, specifically in regard to testing. This finding is similar to previous studies focused on mindfulness in the classroom (Mindful Schools, 2007; Parker et al., 2014). Anecdotes from the interview also revealed changes in students' behaviors surrounding test dates throughout the intervention, inclusive of less chaotic behavior, more calm test taking and preparation, and less concerned comments about grades. These observational anecdotes suggest a perceived decrease in anxiety and stress in students, further supporting the use of mindfulness-based yoga interventions in the classroom setting.

The reduction in anxiety and stress also manifested itself in the form of more positive classroom transitions. As an indicator of pedagogical effectiveness, this outcome reveals the importance of acknowledging students' anxiety and stress in the classroom and providing appropriate interventions to assist with students' learning and the teacher's ability to create an effective instructional environment. The utilization of mindfulness-based yoga interventions as classroom transitions may afford more effective teaching opportunities while enabling students to cope with the many daily stressors of life (Napoli et al., 2005).

Limitations

Results of this study indicated an overall positive change in perceived stress, particularly in remedial males. However, there are limitations within the research that must be taken into consideration. Conducting research in a classroom has its hindrances, due to constantly changing school schedules. Activities such as pep rallies and character education time adjusted the students' daily schedule and routine, often leaving many students confused or tardy. Interruptions from administration, other teachers, or other students also disrupted the intervention throughout the study. These distractions and changes introduced deviations from the students' focus, which may have affected their perceived levels of stress and anxiety. Furthermore, the daily academic foci might have changed students' perceived anxiety and stress levels. The beginning of new material and concepts could increase perceived anxiety and stress among some students as they worked towards grasping the ideas presented. Other students feel perceived stress and anxiety with mathematics in general (Kucian et al., 2018; Mutlu, 2019). Future research should expand the number of classrooms examined with an increased variety of participants to build upon the findings of this study.

Conclusion

In summary, this study provides a platform and further support for the use of mindfulness-based yoga interventions in the elementary classroom. As a novel approach in the realm of education to addressing increased pressure and stress that children in the 21st century encounter, this study revealed that mindfulness-based yoga interventions did not hinder stu-

dents' emotional well-being. On the contrary, such interventions suggest an advantageous means to assist in the development of the cognitive, social-emotional, and physical domains, while simultaneously promoting a positive classroom environment that enables effective instruction and learning to transpire.

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Effects of Several Warm-Up Protocols (Static, Dynamic, No Stretching, Greek Traditional Dance) on Motor Skill Performance in Primary School Students

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Abstract

WThe aim of the present study was to compare the effects of four warm-up protocols on agility, strength, static and dynamic flexibility in primary school students. The participants were forty-four students of a primary school (19 boys and 25 girls) and the mean age of the children was 11.7±0.47. All of them executed, in four different days, one of the following protocols: (a) 3 minutes of jogging followed by 5 minutes of static stretching, (b) 3 minutes of jogging followed by 5 minutes of dynamic stretching, (c) 3 minutes of jogging followed by a 5-minute break (no stretching protocol), and (d) 8 minutes of Greek traditional dances. On the completion of the protocols, the participants did the following tests: the agility shuttle run test (4x10m), the standing long jump test, the sit & reach test, and the active straight leg raise test (dynamic flexibility). According to the results of the repeated measures analysis of variance (ANOVA), the protocol of static stretching showed significantly better scores on static flexibility compared to the protocols of dance and no stretching. As for the long jump, dynamic stretching produced significantly better results compared to static stretching and no stretching. Concerning dynamic flexibility, there were no significant differences between the four warm-up protocols. As for agility, the dance protocol presented significantly better results compared to static stretching. Moreover, girls performed better on the sit & reach test compared to boys. In conclusion, the static-stretch protocol is suggested for lessons that require a maximal range of motion (flexibility). On the other hand, it seems that dynamic stretching is more suitable than the other protocols when the lesson requires lower extremity strength. Moreover, it seems that the dance protocol is suitable for lessons requiring agility. Therefore, teachers should implement different stretching protocols according to the content of the lesson.

Keywords: Warm-Up Protocols, Static Stretching, Dynamic Stretching, No Stretching, Greek Traditional Dance, Primary Education, Students

Introduction

In many countries, research is currently being undertaken in order to improve physical education (PE) curricula, as well as, the structure of PE lessons in schools (Lee et al., 2007). The same applies to warm-up, which is the preparatory part of the lesson.

Warming-up increases body temperature, improves the cooperation and coordination of the muscles, and has positive psychological effects such as enhanced readiness and mood for exercise (Bishop, 2003; Bishop, et al., 2013). Additionally, some studies support that it also helps to reduce injuries (Shellock & Prentice, 1985; Young & Behm, 2002). According to Bishop et al. (2003), the warm-up techniques can be broadly classified into two major categories: passive warm-up and active warm-up. During passive warm-up the muscle temperature rises due to external means (sauna, diathermies), whereas active warm-up, which is used during a PE lesson, involves exercise and leads to major cardiovascular changes to the organism.

Most schoolteachers follow strategies of active warm-up. During the lesson they combine light jogging, in order to raise body temperature, and stretching exercises to improve the flexibility of the joints (Young & Behm, 2002). There are several stretching techniques such as static, ballistic, dynamic, and specialized. The general recommendations for active warm-up mention the introduction of low intensity aerobic workout (e.g. jogging), followed by static stretching (Young & Behm, 2002). Therefore, it has been generally accepted for a long time that a static-stretching warm-up improves student performance, corrects body posture, and reduces injuries (Shellock & Prentice, 1985).

This view seems to be supported by the research of Mayorga-Vega et al., (1994), conducted in 45 students (9-10 years old), underlining the benefits of static stretching in enhancing hamstring muscle flexibility. However, according to other research, static-stretching warm-up reduces maximal strength (McNeal & Sands, 2003). In this particular study, 13 girls (athletes of gymnastics) were measured according to the time they remained on air during jumps after training with and without static stretching. Reduction of their time on air was observed during the jump that followed the static-stretching warm-up. Low muscle temperature is a factor that is reported to contribute in strength loss after a static-stretching warm-up (Hedrick, 2000). Static stretches also seem to be responsible for the decrease of the electrical muscle stimulation, a stretch reflex that starts responding during the eccentric phase of the stretch-shortening cycle (Winchester et al., 2008). While the reduced electrical muscle stimulation may possibly lead as well to lower ability to recruit motor units, which then decreases the production of strength (Bosco et al., 1982). In that same context, the research of Gelen (2011), after measuring a sample of 55 students who were playing basketball 3 times a week, showed that after a static-stretching warm-up the height of jump the students attained was decreased compared to the height of jump achieved after a general warm-up, without stretching.

However, other studies prove that there is neutral effect on the production of strength after static stretching. For example, Behm et al., (2004), studied the effect of warming-up, with and without static stretching, on strength production, balance, and reaction time and did not find significant differences in the production of strength. Nevertheless, their findings showed that both balance and reaction time were reduced after a static-stretching warm-up.

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Over the last years, dynamic stretching that is a warm-up with dynamic workout seems to gain ground in coaches' preferences (Turki et al., 2011; Alikhajeh, 2012; Alikhajeh et al., 2012). Dynamic stretching consists of a series of low, moderate, and high intensity exercises in which both upper and lower extremities contribute and achieve stretching (Faigenbaum et al., 2006). According to many studies, dynamic stretching indeed seems to have a positive effect on strength and agility (Yamaguchi et al., 2005; Gelen, 2011). Similar positive effects of dynamic stretching have also been recorded in many studies on speed and performance improvement, generally (Fletcher, 2010; Behm & Chaouachi, 2011). Researchers have also focused on the reasons why dynamic-stretching warm-up with has a positive effect on maximal strength production. For example, the study of Yamagushi & Ishi (2005) reports these reasons and it is assumed that the muscles' temperature rises as they are joined actively and rhythmically in order to stretch a specific muscle group during a dynamic warm-up (Yamagushi & Ishii, 2005). An alternative interpretation is that dynamic stretching may cause a meta-stimulative lift, in other words, a temporary improvement in muscular performance after a previous contraction.

This point is also supported by the research findings of Chatzopoulos et al., (2014) who compared the effects of the three different protocols on balance, agility, reaction time, and movement time during upper-extremity movements. The sample of this research was 31 student-athletes, boys and girls. The three protocols consisted of (a) 3 minutes of light jogging followed by 7 minutes of static stretching (SS), (b) 3 minutes of light jogging followed by 7 minutes of dynamic stretching (DS), and (c) 3 minutes of jogging followed by a 7-minute break (LS). According to these research results, static stretching had a negative effect on balance, agility, and movement time compared to dynamic stretching. Similar findings were produced by the research of Patrick Troumbley (2010), in which the two warm-up protocols of dynamic and static stretching were applied to 14 men and 10 women, and their effect on the time of preparation for some fast movements of agility was examined. The results showed that dynamic stretching had the fastest time of preparation for agility exercises (Troumbley, 2010).

All the aforementioned studies have focused either on athletes of different sports (Gelen, 2011) or on secondary school students (Chatzopoulos et al., 2014). Few studies have generally been realized on the effects of the different warm-up protocols, especially on PE lessons in primary education. One of these studies was the research of Coledam et al., (2012) Paludo, De Oliveira and Dos-Santos (2012), which aimed at comparing the effects of dynamic stretching to a "tag" game. There were no significant differences between the dynamic workout and the game, neither in agility nor in strength. In particular, the two warm-up models presented similar effects on shuttle run and vertical jump in children. Moreover, there was no difference between the results of boys and girls.

There are studies on dance warm-up (Morrin & Redding, 2013; Lima et al., 2018; Sofianidis et al., 2009; Koutedakis et al., 2009; Venetsanou & Kambas, 2010; Lykesas et al., 2016) but they refer to ballet and they mainly concern its own warm-up protocols. There is no research that deals with dance as a warm-up protocol and this is due to the fact that ballet dance movements are highly demanding. Nevertheless, Greek traditional dance could be used as a warm-up protocol based on the fact that, on the one hand, there are traditional dances of moderate intensity, which have been used as a therapeutic protocol for elderly patients, on the other hand, it has been demonstrated that the Greek traditional dance can be utilized as a means to promote the motor skills of children even at a pre-school age (Lykesas, et al., 2003). Although the use of the Greek traditional dance as a warm-up protocol may well be considered valid, no empirical evidence of this possibility has been provided for the moment, and there is no research that examines this possibility. In order to examine this prospect, several warm-up protocols may be compared, including static stretching, dynamic stretching, no stretching, and the use of Greek traditional dance as a warm-up protocol.

Based on the above, the purpose of this study was to compare the effect of several warm-up protocols (static stretching, dynamic stretching, no stretching, and Greek traditional dance) on agility, strength, as well as static and dynamic flexibility in primary school students.

Methodology

The research sample comprised forty-four (n= 44), male and female, (25 girls and 19 boys) fifth and sixth graders attending a primary school of an eastern suburb in the Prefecture of Thessaloniki. Before data collection, the participants attended one orientation session, in which they were familiarized with the stretching procedures and the performance measures. After the orientation period the participants were divided randomly into four groups (10-12 children), and all performed the four protocols at a random order on four different days. The first group consisted of 11 children (5 boys, 6 girls), the second group of 11 children (5 boys and 6 girls), the third group of 11 children (5 boys and 6 girls), and the fourth group of 11 children (4 boys and 7 girls).

The protocols and the tests were administered in a randomized order to minimize potential order effects. For example, on the first day the first group performed the static stretching protocol (SS), the second group the dynamic stretching protocol (DS), etc. The warm-up protocols were executed in approximately 8 minutes. Apart from the protocol of the Greek traditional dance, all participants started the warm-up process with three minutes of light jogging followed by stretching or by a 5-minute break (no stretching protocol). The stretching protocols used in this study were consistent with general warm-up recommendations for children and are representative of a general warm-up routine used by physical education teachers (Chatzopoulos, et al. 2015; Faigenbaum, et al. 2005). After completing one of the warm-up protocols, the participants performed the test measures. The time between finishing the warm-up and beginning the testing was 2 min. A similar experimental set-up has been used by Chaouachi, et al. (2010) and Chatzopoulos, et al. (2019).

During all days the same PE teacher was responsible for all measurements. All measurements took place at the school's gym, which met the prerequisites of the same environmental conditions with stable temperature. The measurements were realized in December, during the period of two weeks, and on nonconsecutive days. In order to avoid the effect of the previous procedure, a period of two days followed each measurement. All measurements took place were realized between 9-11a.m., and all children wore tracksuits and sneakers. The students had not suffered injuries or other health problems for the last days before conducting the protocols neither during the procedure itself. They were also asked to avoid any laborious physical activity before measurements and not to consume liquids and food that could influence their performance. Each student's guardian had given his/her written consent before the students participated in this research. The study was realized according to the Code of Conduct for Research of the Aristotle University of Thessaloniki.

Description of the Warm-Up Protocols

Static stretching protocol

The three minutes of light jogging were followed by four exercises of static stretching for the muscle groups of quadriceps, back thighs, gastrocnemius muscles and adductor muscles accordingly. Every muscle group of one leg was stretched

for thirty seconds and right after that this stretching was repeated for the same muscle group of the other leg. This sequence was executed twice.

Dynamic stretching protocol

The dynamic-stretching program consisted of seven exercises for the same muscle groups of the lower extremities in which the static stretching was applied. The dynamic stretching was executed in a 15m distance. The participants performed each exercise from the one side of the 15m line to the other in 10 seconds and, right after that, they returned to their initial position in other 10 seconds. There they rested for 10 seconds and continued with the following exercise. This procedure was repeated the same way one more time. The dynamic exercises were as follows: 1) the heels hit the buttock alternately as you move in a straight line; 2) high skipping, the knees go upwards alternately forming a 90-degree angle, while the hands being curved move back and forth in the opposite direction; 3) big steps forwards with a leaping movement; 4) splits with stretched legs and hands on the back; 5) side steps; 6) the Frankenstein walk, the hands are extended and the legs alternate straight and go upwards till the height of the hands; 7) walking the distance on toes and coming back walking on heels.

Protocol without stretching

The participants realized twelve minutes of light jogging.

Greek traditional dance protocol

The participants performed four Greek traditional dances forT 10 minutes (2.5 minutes each), a Macedonian dance: Syre-Syre, a Thracian dance: Trohiro, a Cretan dance: Pentozali, a dance of Epirus: Neratzia. The students moved continually during the Greek- traditional-dance protocol. The selection criteria of the above dances were the following: the different rhythmical speed (the movement regarding the parameters of time and flow), the space (as to different directions and levels), as well as, the combination of simple and complex motor skills. The order of the dances was as follows: Neratzia (slow tempo, 108 beats/min), Syre-Syre (medium tempo, 118 beats/min), Trohiro (medium tempo, 122 beats/min) and Pentozali (fast tempo, 128 beats/min).

Measurements

Upon completion of each warm-up protocol the children did the following tests:

Agility shuttle run test (4X10)

The 4x10 m shuttle run test consisted of running back and forth between two lines, which were 10m apart. The test included four sponges that were carried one by one to the different lines. At the end of each track section, the participant deposited and picked up a sponge from the line. The total distance run was 40m (Ruiz et al., 2006). The performance was recorded in seconds by using a stopwatch to an accuracy of 0.1 s.

Standing long jump

The long jump evaluated the lower extremity strength. All children performed two long jumps from a standing position and the longest jump was used for data analysis (length value cm).

Sit and reach

The children were required to sit with legs together, knees straight, and feet placed against the testing box. They reached forward, as far as possible, and held this position for approximately 2 seconds. The children's score for this test was given based on the final position they reached. The children performed two trials and their best performance was used for data analysis. The test was performed according to the manual of the Eurofit handbook in a self-build construction (Adam, et al., 1988).

Dynamic flexibility (active straight leg raise test)

Hamstring flexibility was measured with an electro-goniometer (0.02° accuracy, sampling frequency 100 Hz, www.vernier.com) using the Active Straight Leg Raise test (Ylinen, et al., 2010). The participant laid supine with hips and knees extended. The greater trochanter was used as a reference point for the axis of the goniometer, and the lateral femoral epicondyle was the other reference point (0°). The participant lifted twice the leg, as high as possible, while keeping the knee extended with 10 seconds rest as an interval. The best score of these measurements was used for data analysis.

Statistical Analysis

Descriptive statistics indicators like the mean and the standard deviation were used while the analysis of variance (ANOVA) with repeated measures was used in order to explore the differences among the four warm-up protocols, with gender as a factor and the four warm-up protocols as repeated measures. The Bonferroni-test was used for the post-hoc analyses. Mauchly's sphericity test was used to evaluate the sphericity of the variance. The statistical significance was established at $p < .05$ and the confidence interval was 95%. The statistical software used to process the data of the measures was SPSS (version 20).

Results

Agility Test

Table 1 displays the mean scores (*M*) and the standard deviation (*SD*) for boys and girls as far as agility is concerned.

Table 1. *Mean scores (sec) and standard deviation of the test on agility (sec)*

Warm-up protocols	Gender	*M*	*SD*
Greek traditional dance	Male	12.09	.97
	Female	12.51	1.04
	Total	12.33	1.02
No stretching	Male	12.20	.96
	Female	12.68	1.12
	Total	12.48	1.07
Dynamic stretching	Male	12.15	.92
	Female	12.62	1.26
	Total	12.42	1.14
Static stretching	Male	12.34	1.04
	Female	12.91	1.25
	Total	12.66	1.19

Mauchly's sphericity test showed that there is no significant statistical difference within variance ($X^2 = .512$, $p = .992$). According to the ANOVA results, there were no significant differences between the two genders ($F_{(1,42)} = 2.881$, $p = .096$). Moreover, there were no significant interactions between the warm-up protocols and gender ($F_{(3,126)} = .295$, $p = .828$). However, the main effect of the warm-up protocols was statistically significant ($F_{(3,126)} = 5.011$, $p = .002$). According to the Bonferroni-test results the Greek-traditional-dance protocol displayed significantly better performance than the static-stretch protocol ($p = .012$).

Long Jump Test

Table 2 displays the mean scores (*M*) and the standard deviation (*SD*) for boys and girls regarding long jump.

Table 2. *Mean scores (cm) and standard deviation of the long jump tes*

Warm-up protocols	Gender	*M*	*SD*
Greek traditional dance	Male	145.30	.97
	Female	134.37	1.04
	Total	139.11	1.02
Dynamic stretching	Male	149.72	.96
	Female	136.70	1.12
	Total	142.36	1.07
No stretching	Male	144.18	.92
	Female	131.73	1.26
	Total	137.13	1.14
Static stretching	Male	145.44	1.04
	Female	132.50	1.25
	Total	138.11	1.19

Mauchly's sphericity test showed that there is no significant statistical difference within variance (X^2= 9.550, p= .080). There were no significant differences between the two genders, ($F_{(1,42)}$= 3.003, p= .070). Moreover, there were no significant interactions between the warm-up protocols and gender ($F_{(3,126)}$= .227, p= .877). The main effect of the warm-up protocols was statistically significant ($F_{(3,126)}$= 5.043, p= .002). According to the Bonferroni-test results the dynamic stretching protocol displayed significantly better performance than the protocols of static stretching (p= .017) and no stretching (p= .001). There was no significant difference between dynamic stretching and the Greek traditional dance.

Static Flexibility Test (Sit and Reach)

Table 3 displays the mean scores (*M*) and standard deviation (*SD*) for boys and girls as far as the static flexibility test is concerned.

Table 3. *Mean scores (cm) and standard deviation of the static flexibility test*

Warm-up protocols	Gender	*M*	*SD*
Static stretching	Male	25.54	6.86
	Female	29.26	7.21
	Total	27.65	7.23
No stretching	Male	24.30	7.33
	Female	27.18	7.42
	Total	25.93	7.45
Dynamic stretching	Male	23.52	7.14
	Female	28.65	8.25
	Total	26.42	8.13
Greek traditional dance	Male	23.69	7.49
	Female	27.86	7.52
	Total	26.05	7.72

Mauchly's sphericity test showed that there is no statistically significant difference within variance (X^2= 9.070, p= .067). According to the ANOVA results there were no significant interactions between the warm-up protocols and gender ($F_{(3,126)}$= 1.530, p= .209). However, there were significant differences between the two genders, ($F_{(1,42)}$= 4.131, p= .047) with girls performing statistically better in all protocols compared to boys. Furthermore, the main effect of the warm-up protocols was statistically significant, ($F_{(3,126)}$= 4.270, p= .006). According to the Bonferroni-test results the static stretching protocol displayed significantly better performance compared to no-strech (p= .029) and the Greek-traditional-dance protocols (p= .002).

Dynamic Flexibility

Table 4 displays the mean scores (*M*) and standard deviation (*SD*) for boys and girls as far as dynamic flexibility is concerned.

Table 4. *Mean scores (degrees) and standard deviation (SD) of the dynamic flexibility*

Warm-up protocols	Gender	*M*	*SD*
Static stretching	Male	105.09	9.67
	Female	104.39	8.18
	Total	104.70	8.78
Dynamic stretching	Male	105.30	8.14
	Female	105.20	5.07
	Total	105.24	6.51
No stretching	Male	105.24	7.80
	Female	104.29	8.09
	Total	104.70	7.91
Greek traditional dance	Male	105.57	8.18
	Female	103.39	7.03
	Total	104.34	7.55

Mauchly's sphericity test showed that there is no significant statistical difference (X^2= 9.751, p= .083). The main effect of the warm-up protocols was not statistically significant, ($F_{(3,126)}$= .172, p= .915). There were no significant differences between the two genders, ($F_{(1,42)}$=.335, p= .565). Moreover, there were no significant interactions between the warm-up protocols and gender, ($F_{(3,126)}$= .325, p= .807).

Discussion

According to the findings, the traditional dance protocol showed statistically significant higher scores in agility compared to the static-stretch protocol. However, it did not display better scores in any of the other measurements. Hence, the question that arises from these findings is whether the Greek traditional dance should be used as a warm-up protocol. In order to give an answer to this, it is worth examining the findings in detail.

In terms of agility, it was expected that the dynamic-stretch protocol and the traditional dance would display better results. The mean scores confirmed this expectation. However, only the mean scores of the dance protocol displayed significantly better scores than the static protocol. The fact that there was no statistical difference between the static protocol and the dynamic protocol complies with the research by Faigenbaum et al. (2006) and Chaouachi et al. (2010). Chaouachi et al. (2010) attributed the lack of significant difference between these two protocols to the recovery time between the stretching and the measurements and considered that a shorter than 5-minute recovery time between the SS and the measurement had affected the results. For this reason, they suggest that the measurements take place at least 5 minutes upon completion of the static stretching (Chaouachi et al., 2010). Additionally, they agree with the research findings of Lykesas et al. (2003) in which a group of pre-school students, participants in organized after-school activities, displayed statistically significant differences in motor flexibility, fluency and originality, since they were participating in after-school activities. On the other hand, the findings of Mc Millian et al. (2006), Little et al., (2006), Van Gelder et al. (2011), and Chatzopoulos et al. (2014) do not coincide. The common characteristic of these studies is that their sample was teenage and adult athletes. Hence, the

different results to this current research could be attributed to the early age of the sample and the fact that the children did not participate in after-school training at sports clubs.

According to the findings, the static-stretch protocol displayed significantly better performance than the dynamic-stretch and the Greek-traditional-dance protocols. The primacy of static stretching could be explained by the increase of the joints' amplitude of movement during static stretching (Young & Behm, 2002). This finding coincides with those of Behm, et al. (2004), Paradisis et al. (2014), Mayorga-Vega et al. (2014), Chan et al. (2001), Davis et al. (2005), Bacurau et al. (2009) and Samson et al. (2012). However, there is also a category of research that has reported non-significant differences between static and dynamic stretching in terms of flexibility (Perrier et al., 2011). Another relevant research in children (Faigenbaum et al., 2005), under similar conditions to this one, showed that there were no differences between the protocols of static and dynamic stretching. The researchers assumed that the non-significant differences may have been caused by the time elapsed between the warm-up protocols' conduct and the flexibility test which was realized 20 to 25 minutes after the warm-up exercises. Moreover, only the measurement of flexibility presented differences between the two genders, with girls displaying better results. This finding is in accordance with other similar research (Kubo et al., 2003). Women are usually more flexible than men, especially in lower extremities, due to the skeleton form of the pelvis. As girls approach adolescence they reach a level of flexibility that may be maintained or decreased during adulthood (Docherty & Bell, 1985).

In terms of dynamic flexibility, there were no significant differences among the warm-up protocols. The results of this research comply with the research of Amiri- Khorasani et al. (2011), which presented the significant effect of dynamic stretching compared to the static one, as far as the dynamic warm-up of professional football players is concerned. It is possible that the difference in age and the experience of professional football players in this specific movement may have determined the difference in the results.

Finally, concerning the long jump there were significant differences between the dynamic-stretch protocol and the dance protocol but still not between the dynamic and static- stretch protocols. The last finding agrees with the corresponding results reported by Faigenbaum et al. (2005), who also conducted research in children. It does not agree though with the findings of the research by Behm and Chaouachi (2011), Alikhajeha (2012) and Andrejić (2012) that mention a significant difference between static and dynamic stretching. Fletcher's research (2010) on the effect of dynamic stretching on strength used different intensity protocols (low and high speed of performance) and reported that the high-intensity protocol displayed better results compared to the low-intensity protocol (Fletcher, 2010). It may, therefore, be useful for future research to study the factor of rhythm in the performance of dynamic stretching, in primary school students. The high-intensity protocol that was applied to trained adults may possibly be too tiring for untrained primary school students. Further study on this is needed as the overall research on the significant differences between static and dynamic stretching had male and female college students, who were training in several sports on a continuous and regular basis, as a sample. The sample of this current research was students of the fifth and the sixth grade of a primary school and none of them was working out systematically. According to Magnusson et al. (1994), adults who train actively respond differently to static stretching compared to minors. This is due to the toughening of the muscle-tendon unit and the age-related decrease of its flexibility (Magnusson et al., 1994). It would be interesting for future research to study the effect of warm-up protocols on a group of children who follow an intense and diverse after-school sports training, as well as, to compare these results to those of children who do not follow an additional extra-curricular training.

Apart from the level of training, the age of the sample could have also influenced the non-significant difference between dynamic and static stretching in the long jump. The effect of static stretching on children may be different from that on adults. Adults present lower flexibility compared to children due to calcium deposition, toughening of the joints, and the different composition of muscle fibers from adipose and collagen fibers (Holloszy et al., 1995).

Concluding Remarks

In conclusion, based on the research results, the warm-up with static stretching presents a positive effect on static flexibility so its use prior to exercises of artistic and rhythmic gymnastics is highly recommended. As for team sports like basketball, volleyball, handball, and football, which are key elements of the school subject of physical education, both protocols of static stretching and Greek traditional dance may be incorporated and used, in terms of agility and dynamic flexibility, as, according to this study, there was no significant statistical difference between them. Overall, relevant data for the warm-up of children arise from this study that could be valuable to primary school PE teachers and coaches who work with children, and they may contribute to further improve the quality of the lesson.

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ICT-Driven Writing and Motor Skills: A Review

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Abstract

The development of writing skills is recognized as a mandatory process for initial education and the foundation of all essential learning. Writing skills are crucial to children's socialization and interaction with their environment as they grow. The development of writing skills has been linked to a complex set of key factors, but is not yet clear enough. In the context of 21st-century education, and to increase understanding of this phenomenon, a systematic literature review of 40 years of published studies on the subject was carried out. The results revealed how relevant the integration of gross and fine motor skills is, along with the use of Information and Communication Technologies (ICT). The development of writing skills in game-based learning environments and curricular articulation of physical education and ICT-mediated writing in early childhood education are also significant factors to consider.

Keywords: Writing Skills, Gross Motor Skills, Educational Technology, Collaborative Writing

Introduction

A priority in educational systems around the world is the development of writing skills in children. Writing is not only the way to express their emotions and feelings, but the mainstay of their communication and socialization development (Akkaya & Kırmızı, 2010).

There are multiple perspectives on the acquisition of writing skills: language proficiency (Maftoon & Seyyedrezaei, 2012; Tengku-Mahadi et al., 2018), global familiarization with the graphic code (Kiiveri & Määttä, 2012; Romero et al., 2005), psychomotor condition (Barbot et al., 2012; Erdogan, 2011), and the laterality and direction of the stroke (León et al., 2017; Sitnikova, 2012). However, the key factor to consider is progressiveness: to lay the substrate of writing skills development it is necessary to generate enough gross motor patterns and eye-hand coordination in children in order to be able to gradually generate subsequently finer motor processes (Gaul & Issartel, 2016).

In this regard, Smitha and Renumol (2018) defined the proper development of fine motor skills as what allows the school-age child to correctly perform basic positions and movements for writing. This includes the ability to make a fist, the proper finger-to-thumb opposition, and repetitive tapping. In addition, De Juanas Oliva (2014) highlighted brain lateralization as relevant, along with its consequential strengthening of a preferred skillful hand to use in writing.

In such a context, teachers responsible for physical education must work together with writing teachers. In fact, physical education activities should provide the child awareness about breathing, muscular tension, fatigue, and relaxation (Ghahari & Farokhnia, 2017); such proprioception should allow them to overcome adverse conditions for the development of writing. In this regard, Weigel, Martin and Bennett (2010) showed family routines and resources as well as tension and stress in students as hindrance factors to proper writing as required by the school system.

In the absence of ICT, the child must properly develop certain basic pre-writing motor skills before learning to write. The main one is pictography, the exercise of drawing as an articulated expression of thoughts and motor development (Mackenzie & Veresov, 2013). However, in the context of a hyperconnected and increasingly digitally-mediated world, writing skills and their prior motor development are different from the ones that children acquire in traditional teaching contexts. The widespread use of digital and mobile devices such as tablets or smartphones entails a different understanding of writing skills.

Hence, alternative writing instruction methods based on the use of Information and Communication Technologies (ICT) have emerged. The pervasive use of keyboards and touch screens made writing skills a matter of distinguishing graphs or letters without learning the handwriting stroke, thus avoiding previous stages such as scribbling (Mangen & Balsvik, 2016; Vertecchi et al., 2016).

In this sense, Genlott and Grönlund (2013) designed the "Integrated Write to Learn" method (iWTR), an experimental way to teach children the minimum skills required for handling digital devices (turning them on and off, entering and closing a text editor, using the keyboard, etc.), and later teaching them to write with them. Through the use of digital media it was possible to help the children build words, acquire a lexicon and then collaboratively create coherent sentences and texts.

An initial search on the topic showed the comparative volume of research on ICT-related writing skills vs non-ICT writing skills (Figure 1).

The use of ICTs in learning has shown positive effects on children's motor development (Strand & Nielsen, 2017), and a very high potential to transform teaching in primary education (Martínez Parejo, 2016). However, it is necessary to develop a better understanding of the effects and relationships between motor development, writing skills and the use

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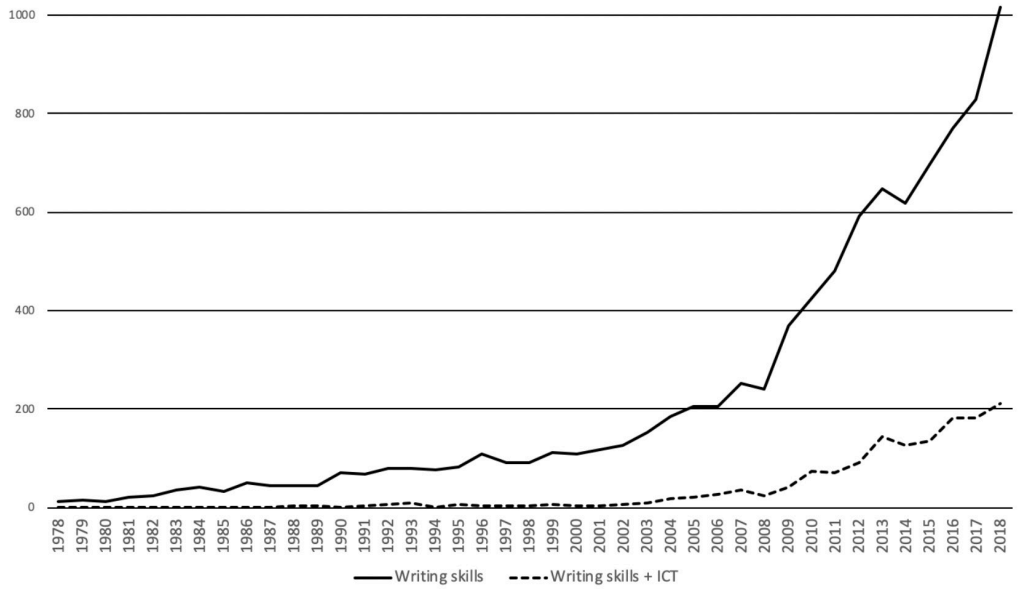

Figure 1. Comparative of Writing Skills Research with/without an ICT Component
Source: Own elaboration based on Scopus data

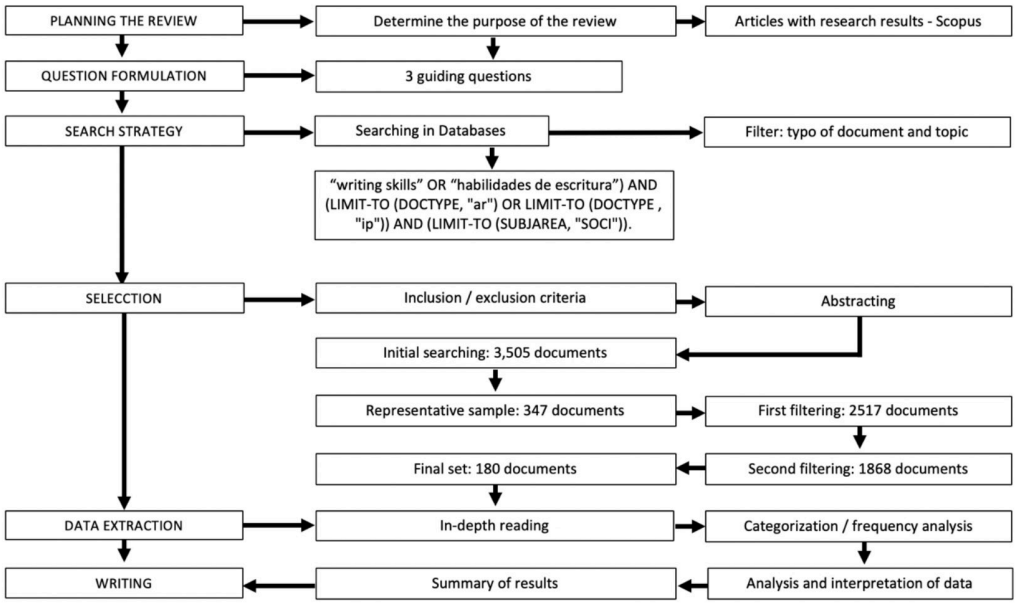

Figure 2. Review Method
Source: Own elaboration

of ICT. This systematic review of scholarly literature on writing skills aimed to identify commonalities between the use of ICT and the development of gross motor skills. By articulating curricular and didactic trends in both areas, a paradigm shift may emerge in primary education.

Method

This review followed the steps by Lavallee, Robillard & Mirsalari (2014), as shown in Figure 2:

Planning the Review

In this first step, the team established the purpose of the review, the type of documents to be reviewed, and the sources to retrieve them. The review focused on key factors for the development of writing skills, particularly to identify which of them are acquired through the development of gross motor skills and which are susceptible to be obtained directly with ICT. The search was limited to research articles published in Scopus-listed journals, since the Scopus database has the highest coverage of high-impact indexed publications in the social sciences. Additionally, the strict application of peer review processes and rigorous acceptance and rejection criteria make Scopus journals high quality sources for a scholarly literature review.

Guiding Questions for the Review

Three main guiding questions were defined as review drivers: (1) What are the key factors in the development of writing skills? (2) Which of those key factors are directly linked to the development of gross motor patterns? and, (3) Which of those key factors may be augmented through the use of ICT?

Search Strategy Definition

First, the Scopus database was queried by type of document and subject, restricting results to articles in the social sciences. The following search criteria and boolean operators were

chained and then queried over Scopus: ("writing skills" OR "writing competencies") AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "ip")) AND (LIMIT-TO (SUBJAREA, "SOCI")).

Article Selection

The initial criterion for article inclusion was the presence of the search terms either in the title or in the abstract. The second criterion was that each article included results of a study on the subject area. Based on the results of an initial search, only articles published in the last 40 years were finally included.

The initial search yielded 3,505 documents, for which a representative sample was calculated (*n*= 347) with a 95% reliability and 5% error. Then, a first filtering limited the search to "articles and articles in press" (*n*= 2517), and a second filtering by subject area limited results to "Social Sciences" (*n*= 1868). The articles were sorted by number of citations in descending order to ensure the highest level of acceptance by the academic community. Filtering by subject area guarantees to stay within the framework of educational research, which in turn is labeled under "Social Sciences".

After the filtering processes reduced the corpus (*N*= 1868), a proportional sample was determined (*n*= 180). The reduced sample kept the proportionality of articles per year, as follows:

- From 1978 to 1998: 18.33% (*n*= 33).
- From 1999 to 2006: 31.66% (*n*= 57).
- From 2007 to 2018: 50% (*n*= 90).

Data extraction and synthesis

In an in-depth reading process, key ideas were extracted from each reviewed article, and added to the analysis matrix after having been approved. The data in this matrix was sorted by publication time, organized in time periods, and then terminologically unified and categorized. Additionally, a co-occurrence analysis was conducted to identify terms with the highest frequency of appearance and connections between those key ideas.

As a triangulation process, an adequate level of inter-rater assessment for the dataset in the analysis matrix (Warrens, 2013) was established. Key ideas were extracted by two different observers, whose results were checked by determining their mutual Cohen's Kappa coefficient (*k*= .538). An 82% of agreement was established from there. After nine (9) items were identified to be in disagreement between observers, they were excluded from the overall analysis.

Results

Bibliometric results

The reviewed articles (*N*= 180) were published in 87 journals in a relatively homogeneous manner. Most journals contributed only one article to the reviewed corpus (60.9%; *n*= 53), while 20.7% of them (*n*= 18) contributed two articles, and another 6.9% (*n*= 6) contributed three articles. The remaining ten journals were the most relevant: 4.5% (*n*= 4) contributed 4 articles, 1.15% (*n*= 1) contributed 5 articles, 3.45% (*n*= 3) contributed 6 articles, another 1.15% (*n*= 1) contributed 7 articles and finally, another 1.15% (*n*=1) contributed 15 articles.

Table 1 showed the top ten journals by article contribution, with their impact factors and location on the SCImago journal rank (SJR) quartile scale, an indication of the quality of the consulted sources.

Additionally, Table 2 shows the 2017-2018 set of articles with their key ideas and impact factor.

A qualitative categorization process with co-occurrence analysis was conducted (Figure 3), which showed that writing skills were directly related to gross motor skills.

Key ideas related to the development of writing skills

The data analysis yielded a set of 55 key ideas related to the development of writing skills. Figure 4 shows the top 10 key ideas by frequency of appearance in the reviewed articles.

It is also worth mentioning both the topical wide scope of those key ideas and their scattering among the articles reviewed: five (5) key ideas (9.1%) appeared between 20 and 86 times; eight (8) key ideas (14.5%) appeared between 10 and 19 times; thirteen (13) key ideas (23.6%) appeared between 5 and 9 times; sixteen (6) key ideas (29.1%) appeared between 2 and 4 times; and, thirteen (13) key ideas (23.6%) appeared only once.

To begin with, Hier and Eckert (2016), Maldarelli, Khars, Hunt and Lockman (2015), Ahmed, Wagner and López (2014), Olinghouse and Graham (2009), considered that handwriting (6.7%) represented a very important factor in the development of writing skills insofar as it contributes to fluency. Handwriting develops the quality and direction of the stroke, as well as the quality of the graphs and line tracings, which later lead to better reading. As the child's graphs evolve from scribbling to proper writing, the brain is better trained in shape recognition, hence improving its own reading and, progressively, the quality of the spelling.

Table 1. *Top 10- Journals with more articles reviewed*

Journal	Articles by journal	JCR impFctr	SJR impFctr	SJR Quartile
Reading and Writing	15	1.837	1.462	Q1
Journal of Educational Psychology	7	4.433	3.459	Q1
Early Childhood Education Journal	6	0.927	0.597	Q2
Journal of Second Language Writing	6	3.324	2.657	Q1
Journal of Writing Research	6	N/A	1.035	Q1
Computers & Education	5	4.538	2.323	Q1
British Journal of Educational Psychology	4	2.057	1.399	Q1
Journal of School Psychology	4	2.299	1.751	Q1
Learning and Individual Differences	4	1.420	1.129	Q1
Written Communication	4	1.267	0.730	Q1

Source: Own elaboration based on Scopus and WoS data

Table 2. *Key ideas by article 2018-2017*

Source	Key ideas in article	Field-Weighted Citation Impact
(Suggate et al., 2018)	Cognitive and social skills, graphomotor or neuromotor skills, fine motor skills, early reading / emerging reading	6.22
(McMaster et al., 2018)	Planning, review, writing strategy, early writing / emerging writing, transcription, text generation and composition	5.11
(Belet Boyacı & Güner, 2018)	Skills list, joy of writing, authentic material	1.02
(Spengler et al., 2018)	Skills list, cognitive and social skills	4.28
(Sauvé et al., 2018)	Skill/ability, skills list, cognitive and social skills, planning, review, writing strategy	3.05
(Pennington et al., 2018)	Interrelations and change, ICT mediation, disability, differences between written and spoken	2.64
(Gutiérrez-Fresneda, 2018)	Skill/ability, skills list, grammar or spelling, handling punctuation, early writing / emerging writing, phonological awareness & phonology, written code & written language, oral language / oral narrative, speed nomenclature	0.77
(Aghajani & Adloo, 2018)	ICT intermediation, joy of writing, internet as a writing tool, text generation and composition	1.02
(Sulak, 2018)	ICT mediation, internet as a writing tool, writing in elementary teaching	Not yet
(Puranik et al., 2018)	Skill / ability, early reading / emerging reading, parents teaching writing, early writing / emerging writing, oral language and oral narrative	0.79
(Weston-Sementelli et al., 2018)	Text generation essays, reading and writing combination	0.71
(Zhang & Quinn, 2018)	Early writing / emerging writing, emerging literacy	1.54
(Spencer & Petersen, 2018)	Early writing / emerging writing, transcription, written codes & written language, oral language and oral narrative	Not yet
(Koutsoftas, 2018)	Skill / ability, skill, phonological awareness & phonology	2.03
(Guo et al., 2018)	Early reading / emerging reading, grammar and spelling, early writing / emerging writing, combination of reading and writing, individualized instruction	Not yet
(Berninger et al., 2017)	Disability, dyslexia, dysgraphia	7.53
(Jiménez, 2017)	Skill / ability, disability, early writing / emergent writing, transcription, text generation and composition, spelling	3.76
(Bingham et al., 2017)	Early writing / emergent writing, text generation and composition	6.52
(Camacho & Alves, 2017)	Skill lists, parents teaching writing, early writing / emerging writing, text generation and composition	1.24
(Justice et al., 2017)	Early reading / emergent reading, emergent literacy	0.83
(Sinaga & Feranie, 2017)	Fine motor skills, quality of writing, writing skills with adults	2.90
(Liao et al., 2015)	Satisfaction, skill / ability, Skill lists	5.99
(Zhang et al., 2017)	Skill / ability, Skill lists, grammar or spelling, Early writing / emergent writing, text generation and composition, phonological awareness and phonology, emergent literacy	1.24
(Pavelko et al., 2017)	Satisfaction, skill / ability, Skill lists, disability, Early writing / emergent writing, text generation and composition, authentic material, oral language and oral narrative	0.54
(Daffern et al., 2017)	Skill lists, ICT mediation, grammar and spelling, punctuation management, text generation and composition	0.41
(Korth et al., 2017)	Skill lists, Early writing / emergent writing, emergent literacy	0.66
(Birketveit & Rimmereide, 2017)	Skill lists, illustrated books	0.55
(Rodríguez Fuentes & Gallego Ortega, 2017)	ICT mediation	0.62
(Jafarigohar & Mortazavi, 2017)	Skill lists, Cognitive and social skills	Not yet

At older ages, fluency was understood as a skill for proper reading through an adequate intonation that obeys punctuation marks. Fluency is also the writing skill meaning proper grammar and composition, along with lexical proficiency as required by the subject and audience.

Adding to the above, coherence in writing (18.9%) understood as the ability to proficiently convey meaning in written texts was mentioned in studies as a key factor for evidencing the development of writing skills (Bigozzi & Vettori, 2016; García-Sánchez & de Caso-Fuertes, 2005; Mäki et al., 2001).
McMaster, Kunkel, Shin, Jung and Lembke (2018), Gutiérrez-Fresneda (2018) and Puranik, Phillips, Lonigan and Gibson (2018) studied early/emerging writing and reading (11,1% and 7,8%) and confirmed that there may be considerable individual differences among preschoolers in terms of emerging literacy performance. They distinguished two different but interrelated domains: knowledge of the alphabet and phonological awareness.

Early knowledge of the alphabet was found to be a key factor in the development of later reading and writing, but the process draws upon multiple interrelated developmental areas (Dickinson & McCabe, 2001; Zaretsky et al., 2009). This includes development of gross motor skills, pictography and enjoyable, playful learning; children who receive positive stimuli learn to read and write faster.

In that sense, Troia, Shankland and Wolbers (2012), Mikulski (2006), Mutlu, Cimpolat and Süğümlü (2019) and Christensen (2004) showed that recreational and motivational activities are positively linked to the development of literacy. While the mo-

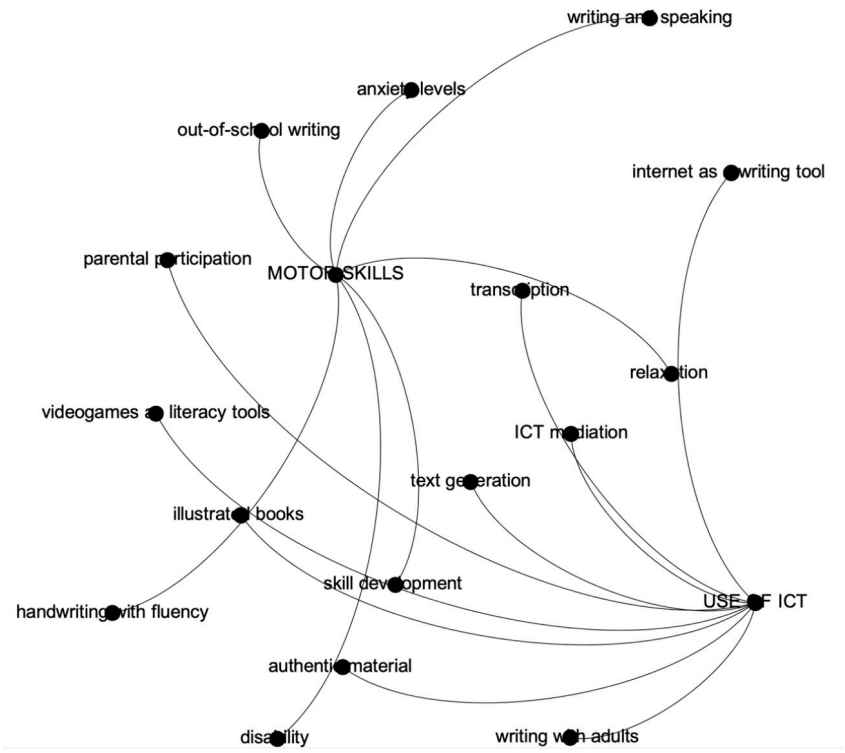

Figure 3. Co-occurrence Mapping and Categorization of Key Ideas
Source: Own elaboration

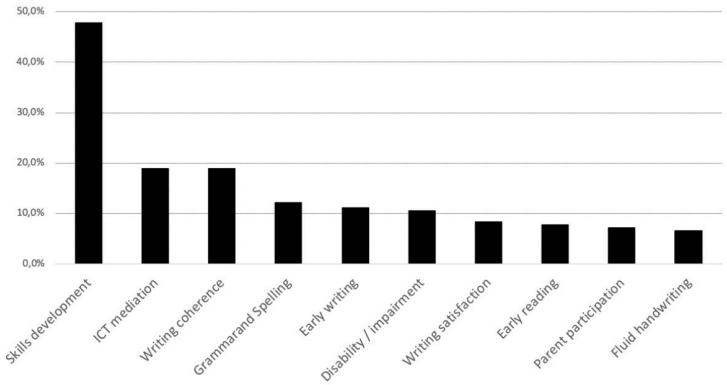

Figure 4. Top 10 Most Frequent Key Ideas
Source: Own elaboration

tivation to write can be substantially weaker than the motivation to speak or read, such challenging activities usually have a positive effect on the process.

Finally and expectedly, both disability and impairment in children (10.6%) held back the development of writing skills (Berninger et al., 2017; Jiménez, 2017; Pennington et al., 2018). Contrariwise, parent participation (7.2%) had a positive effect on their literacy (Camacho & Alves, 2017; Hwang et al., 2014; Neumann, 2014). In 2001, the World Health Organization included writing as one of the biggest problems for children with disabilities in school. Indeed, writing is an essential activity allowing students to express their knowledge and ideas and to participate in most of their academic activities. Hence, parental support is crucial for children with disabilities, as they strengthen socialization and literacy development at home to complement what is difficult to implement at school.

The key idea of the development of motor skills showed direct association with seven others, namely: development of skills (*n*= 86; 47.8%), disability (*n*= 19; 10.6%), handwriting with fluency (n=12; 6.7%), relaxation (*n*= 2; 1.1%), differences between writing and speaking (*n*= 2; 1.1%), anxiety levels (*n*= 1; 0.6%) and out-of-school writing (*n*= 1; 0.6%).

On their part, key ideas related to the use of ICT were: ICT mediation (*n*= 34; 18.9%), text generation and composition / writing coherence (*n*= 34; 18.9%), parental participation (*n*= 13; 7.2%), internet as a writing tool (*n*= 11; 7.1%), transcription (*n*= 8; 4.4%), writing with adults (*n*= 6; 3.3%), authentic material (*n*= 6; 3.3%), videogames as literacy tools (*n*= 1; 0.6%), and, illustrated books (*n*= 1; 0.6%).

Drawing on neurodevelopmental theory, Wollscheid, Sjaastad and Tømte (2016) asserted that one of the main factors in the development of basic writing skills is the improvement of other motor developmental skills (47.8%) which drive the children's levels of attention. Children begin to create mental structures while exploring the world through body movement during play and locomotion; creating connections by these experiences will soon lead to proper development of

an enriched lexicon. That is considered a direct and prior step to writing (Aravena & Quiroga, 2018). Examples of the above process can be found in Kellogg (2008), Kim, Al Otaiba and Wanzek (2015) and Alevriadou and Giaouri (2015).

Writing and ICT skills

A large number of the reviewed studies (*n*= 34) found that ICT facilitates writing development processes, beyond the operational and process perspective (Hwang et al., 2014; Pennington et al., 2018; Sulak, 2018). Notably positive aspects include the strengthening of writing skills; erasing and correcting without leaving a trace or breaking the paper; and, writing ideas, comments and notes in the same file without messing up what has already been written by the student (Dalton & Hannafin, 1987; Yamaç & Ulusoy, 2016).

In addition to the aforementioned, other articles revealed that using word processors as complementary aids improves basic writing skills such as graph recognition, directional left-to-right writing, and autonomous visual pursuit of the text line (Chiappe & González, 2014; Penuel, 2006). Moreover, the use of ICT while learning to write brings in the concept of "collaborative writing", on which many students share documents and contribute to the same texts, either synchronously or asynchronously through the use of ICT tools like wikis or Google Docs. Researchers observed that during the collaborative process the less experienced writers learned from the more advanced or expert ones, and the general quality of the written product increased. This is mainly due to sequential and iterative polishing of the drafts under multilateral supervision and action (Chen & Yu, 2019; Hadjerrouit, 2011; Karahasanović et al., 2012; Noël & Robert, 2004; Wang, 2016).

Other research has shown that students significantly improve their writing skills in terms of grammar, mechanics, writing style, and referencing after going through a peer reviewed process (Eaton & Wade, 2014; Fedewa & Houghton, 2017).

Discussion

From the previous section, the researchers found a wide variety of key ideas associated with the development of writing skills. A warning for educational researchers and practitioners, the main idea derived from this review was to acknowledge the relevance of interdisciplinary integration around the development of writing. Literature showed the relevance of motor skills development but also warned that the aforementioned integration currently requires incorporation of ICTs. The emergence of new learning-to-write alternatives beyond motor skills development is related to the evolution of web-based technologies and mobile devices (Lavonen et al., 2008; Serouri, 2017). That should be a structural part of the curricular designs for 21st century schools.

One of the most relevant factors found in writing skills development is the parallel learning of orthographic and grammatical handling associated with phonetic exercises (Guo et al., 2018; Spengler et al., 2018; Zhang et al., 2017). In the early school years, the teacher usually conducts reading exercises to ensure proper pronunciation of the graphs, words, phrases and expressions. A child who acquires phonetic processes wrong tends to write wrong; bad diction is a predictor of later deficiencies in writing, including sentence and paragraph construction (Both-de Vries & Bus, 2010; Evmenova et al., 2010). For example, the use of subtitled videos where the child can follow the reading creates an association between visual and hearing processing. If this is also associated with a musical component with rhythm tracking and gross movements, the child will improve or acquire proper spelling, along with better grammar.

It was also noticeable that the link between the development of writing and movement is embedded in the term "psychomotor" (Barbot et al., 2012). The development of writing requires maintaining a proper posture and holding the crayon or pencil for long periods of time. Hence, the child must acquire suitable muscular development and gross motor patterns in specific muscle groups. Properly carrying out these processes will eventually enable adequate fine motor development, the final motor scaffolding of writing (Bindman et al., 2014). It was also found that incomplete motor development at home demands corrective physical education processes at school for recovering it and directly addressing the child's writing difficulties.

After analyzing the results of the review, we concurred with the concept that to be able to write is a basic skill for the future learning of more complex knowledge (Flórez Romero et al., 2006). In fact, writing is a foundation to create such a degree of complexity in the child's knowledge.

In addition, we found that writing provides the means for personal reflection, thought, creativity, creation of meaning and exchange of ideas, as well as a complement to other modes of communication in a world of multimodal texts. While writing in the digital age has become increasingly complex and exposed to global scrutiny, being able to write efficiently with correct spelling, grammar and punctuation remains a fundamental part of being a literate writer.

Literature proved that learning to write has a progressive nature, and that it is important to articulate family and school environments in order to achieve such a significant goal. The strengthening of early writing depends to a great extent on a good coordination of the motor, perceptive and cognitive processes. Motivating children for this accomplishment includes the elaboration of creative texts relating to their tastes, interests and game routines (Liao et al., 2015; Sella et al., 2016).

The specialized literature told us that writing can be taught with or without technological mediations. However, much of the reviewed research concluded that the inclusion of Information and Communication Technologies (ICT) was fundamental in the development of basic writing skills (Awada et al., 2019; Mohankumar et al., 2018). Especially in response to the expectations of education in the 21st century, these skills were linked to the further development of informational skills, understood as a set of knowledge, skills and values applied to the "search, recovery, analysis, treatment, communication and application of information" (Monereo & Badia, 2012, p. 77).

The revision concluded that learning to write in an increasingly technologically mediated, interconnected and global world requires a different perspective of learning to write, perhaps a view where the interdisciplinary exceeds the limits of the compartmentalized and rigid curricula extensively used in elementary and secondary education in developing countries.

We found that such perspective supposes the possibility of curricular articulation of physical education and learning to write in a context where the digital surroundings have a lot to contribute to children and young people's learning experiences. As they are growing in a networked world, playful spaces for learning and motivating are required in the pedagogy for the 21st century.

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