International Electronic Journal of Elementary Education
Vol. 7, Issue 3, June, 2015.

IEJEE
International Electronic Journal of Elementary Education
International Electronic Journal of Elementary Education is an international, multi-disciplinary, peer-reviewed journal that is online published three times in a year. IEJEE aims to provide a platform for the publication of the most advanced high-quality research in the areas of learning, development, instruction and teaching at elementary level.
International Electronic Journal of Elementary Education publishes three issues per year (March, July, and October). IEJEE provides immediate open access to its content on the principle that making research freely available to the public to support a greater global exchange of knowledge.

ISSN: 1307-9298

Abstracting and Indexing:
ERIC, Scopus, ProQuest, DOAJ, Education Research Complete™, Google Scholar, EDNA, Index Copernicus, Norwegian Social Science Data Services, NewJour, Open J-Gate.

ISSN:1307-9298

www.iejee.com

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

Table of Contents

Dear *IEJEE* readers,

We, the board of IEJEE, are enthusiastic about publishing a new issue. This enthusiasm has been the same from the first issue. We are not only learning about the scientific knowledge, methods and applications from different kind of countries, but about publishing academic journal. We know that the learning process and the enthusiasm will continue with every issue.

Publishing a journal is not just limited to routine work or reviewing/publishing of an article. For instance, IEJEE provides a platform for international collaboration along with being an international journal. This platform leads the readers and the authors of IEJEE to work together in a project or for an article. Therefore, IEJEE plays an inspirational role to improve interdisciplinary and international academic works. This work generally take place in our special issues.

We published several special issues such as Reading Fluency, Multilingualism and Multilingual Education in the Nordic Countries, Learning and Instruction in Natural Sciences, Reading Comprehension, Out of School Education and Metacognition. These issues drew high attention from our readers. We are glad to share with you that we will continue to publish new special issues with distinctive content and subjects.

Our endeavors to provide better service to the authors and the readers will continue. We are working on a journal tracking system that will able us to communicate effectively with the authors of the manuscripts and smoothen the reviewing process by reducing some of the technical issues down to zero. We are doing our best to integrate this system sooner.

Thank you to all the researchers and the editors for their contributions to our ever-raising success. Especially, I would like to honor Karen Zabrucky, Georgia State University, due to her valuable contributions and her ideas on our special issues and reviewing processes. Her suggestions and unique ideas encourage us to go further.

Lastly, I congratulate the authors of the articles of June, 2015 issue and many thanks to our reviewers and our editorial board; Dr. Kamil Özerk, Dr. Gökhan Özsoy, Dr. H.Gül Kuruyer, Hasan Tabak, Mustafa Bakır and Ulaş Yabanova.

Sincerely,

Dr. Turan TEMUR

International Electronic Journal of Elementary Education, 2015, 7(3), 281-300.

Assessing the Promise of a Supplemental Reading Intervention for At-Risk First Grade Students in a Public School Setting

Kouider MOKHTARI *

The University of Texas at Tyler, United States

Joanna L. NEEL

The University of Texas at Tyler, United States

Forrest KAISER

Caldwell Elementary School, Tyler, Texas, United States

Hong-Hai Le

The University of Texas at Tyler, United States

Received: 9 April 2015 / Revised: 10 May 2015 / Accepted: 25 May 2015

Abstract

In this exploratory quasi-experimental case study, we assessed the promise of a yearlong supplemental reading intervention with a small pilot group of at-risk first grade readers in an elementary school setting. Using standardized measures of reading proficiency, we found that after 47 hours of one-on-one tutoring instruction, students read significantly more proficiently than did non-tutored students in a matched group of first grade peers in the same school. These results are encouraging in light of literacy research documenting the impact of one-on-one tutoring by qualified tutors of at-risk early grade readers. We used lessons learned from this pilot study to help inform and direct the necessary revisions and refinements of future reading interventions with the goal of building the school's capacity to support the literacy development of at-risk readers so that they can catch up with their typically developing peers.

Keywords: Response to intervention, early literacy instruction, one-on-one tutoring, at-risk readers

Introduction

Students arrive at school around 7:00 a.m. Parents drop them off by the cafeteria, where they get breakfast and meet their tutors.

Denica waits for six-year old Keyonte each tutoring day (names are pseudonyms). Keyonte usually runs 10-15 minutes late. When she picks him up from the cafeteria, they

* ✉ Kouider Mokhtari The University of Texas at Tyler, 3900 University Blvd Tyler, Texas 75799, United States, Phone: (903) 566-7177 E-mail: kmokhtari@uttyler.edu

ISSN:1307-9298

www.iejee.com

usually talk about his morning or the books he read the night before. These conversations help set the stage for the daily tutoring lessons. Denica intentionally asks open-ended questions to help engage Keyonte in purposeful and meaningful conversations. Most morning conversation starters are centered on breakfast or his clothes (he often has on matching sneakers and jackets, or new jeans with cool logos). Gradually, their conversation becomes more centered on books and characters that are interesting to him.

Once upstairs in the school library, they would settle in for their daily literacy lesson. Keyonte often works best when seated side by side at a table with Denica. Working on the floor proved to be too much of a distraction. Sitting beside him allows Denica to easily see how he is reading and point out key words and phrases during picture walks.

Students like Keyonte are often regarded as "struggling" or "at-risk" readers. Most enter first grade with low literacy skills, and are therefore considered unprepared to fully engage in formal school-based literacy activities. On the other hand, these students come to school with an array of talents and home experiences that are critically important for their school success. In our study of what works for struggling first grade readers, we show how schools can bring about significant improvements in reading performance outcomes among these students, by catching them before they fall, providing them with intensive one-on-one instruction, and expert teaching will be necessary. For many of these students, as Marie Clay (2005) observed: "It is the individual adaptation made by the expert teacher to that child's idiosyncratic competencies and history of past experiences that starts him on the upward climb to effective literacy performances." (p. 63).

What research says about how to effectively reach and teach at-risk early grade readers

When it comes to what works when teaching children to read in the early grades, we know one thing for certain: There are no silver bullets. On the other hand, a review of several decades of reading research and long-term data give us a better sense of what works — and, for the most part, it's what we're not doing, which, according to reading experts, includes early detection of reading difficulties, intensive instruction, and expert teaching for all children, especially for those who come from ethnically diverse and/or low-income families (e.g., Au, 2011, Clay, 2005; Taylor, 2007).

For purposes of this article, we will focus on two main lines of literacy research and instruction. The first one examines the characteristics of effective reading instruction programs that have been shown to help at-risk readers catch up to their grade levels. The second line of research examines the degree to which these programs are similarly effective for all children, including those who come from ethnically diverse and economically disadvantaged backgrounds.

What does it take to effectively reach and teach early grade at-risk readers?

Literacy researchers and practitioners generally agree that it is possible to prevent reading problems for most children when they are provided with supplementary instructional support in the form of effective early and intensive literacy interventions (e.g., Clay, 2005; Snow, Burns, & Griffin, 1998; Wasik & Slavin, 1993). Some researchers have shown that almost all first grade children can learn to read, including those who enter school with low levels of literacy and who in the past would have failed to learn to read in first grade (e.g., Taylor, Critchley, Paulsen, MacDonald, & Miron, 2002). A recent U.S. Department of Education report concluded, after a review of evidence from available randomized controlled studies, that one-on-one tutoring by qualified tutors for at-risk readers in Grades 1–3 is effective (Institute of Education Sciences, 2003, p. iii). The report authors further noted "one-on-one tutoring of at-risk readers by a well-trained tutor yields an effect size of about 0.7. This means that the average tutored student reads more proficiently than approximately 75 percent of the untutored students in the control group." (p. 19).

The above findings appear at odds with students' reading performance in many United States schools as revealed by state and national tests of reading proficiency. Report cards such as the National Assessment of Educational Progress (NAEP) indicate that since 2007, nearly two out of three 4th grade students in the U.S. have had reading proficiencies below the level needed to do grade level work adequately (National Center for Educational Statistics [NCES], 2011). State assessments consistently show that as many as 30% of first grade students, on average, enter school with low levels of reading and writing. The number of students in need of reading assistance is much greater for students of low-income families, students with disabilities, and students representing culturally, linguistically, and racially different backgrounds.

So why are there such high numbers of underachieving readers when the research evidence shows that reading problems are preventable for the majority of young children? The answer to this question is complex but depends, to a great extent, on what schools are doing or not doing to prevent and address students' reading difficulties. In our work with struggling readers in school settings, we often find that there is a gap between what is known about best practices in literacy instruction and what happens daily in practice, particularly in classrooms that have a high percentage of underachieving readers. The answer also depends on whether schools have the means and expertise to put in place systems for identifying children at-risk of reading difficulties, providing effective literacy instruction in the preschool and early grades, and supporting the professional learning and development of teachers. Consistent with these observations, literacy researchers have argued for several decades that "few students in the United States regularly receive the best reading instruction we know how to give" (Allington, 2011), and that classroom literacy instruction seldom reflects best practices as identified in the research (Taylor, Peterson, Pearson, & Rodriguez, 2010).

Richard Allington, a leading literacy researcher who has spent many years studying exemplary elementary classroom teachers, has argued that as a literacy community, we know how to teach nearly every child to read by first grade. Unfortunately, few schools are doing what they need to do to help students most at-risk of reading failure. In an article published in *Educational Leadership*, Allington and Gabriel (2012) outline six elements of effective reading instruction that they assert "do not require much time or money—just educators' decision to put them in place" (p. 1). The key to reaching the goal of teaching every child to read by first grade depends on providing opportunities for every child to experience these research-based elements of reading instruction every day. According to Allington and Gabriel (2012), in order to help all students become competent, independent readers and writers, classroom teachers should (a) give students an opportunity to read something that appeals to their interests and needs, (b) read something they can accurately read and understand, (c) write something that is meaningful to them, (d) talk about what they read or write with someone, and (e) hear a fluent adult reader read aloud every day.

Drawing from research on effective reading instruction during the last four decades, as well as her own research examining the "how" as well as the "what" of effective elementary reading instruction practices, Taylor and colleagues concur that many of the classroom literacy instruction practices she observed in thousands of classrooms over a period of several years are inconsistent with research-based instruction practices (Taylor, 2007; Taylor et al., 2010). They argue that to reach the goal of helping all children in the elementary grades succeed in reading to their fullest potential, teachers and administrators within schools should make a concerted effort to work together to develop and deliver a sound school-wide reading program. She further notes that while schools know that a wealth of information is available to help them move closer to helping every child become a reader, putting all the relevant pieces together remains a challenge. Moreover, she points out that ongoing professional development in which teachers work together within their buildings to reflect on their practices is an important first step in achieving this goal.

Researchers, policy makers, and practitioners generally agree that the first three years of classroom instruction are critically important for preventing students from falling behind and preventing reading failure. During these critical years, schools lacking the expertise and/or the resources to put in place a system for providing expert reading instruction for all students are likely to create a pool of students who will become struggling readers. By and large, during the past several decades, schools have made substantial progress in addressing reading difficulties by designing effective early reading intervention programs. One of the most notable examples of successful early intervention programs is the *Reading Recovery* model, which uses one-to-one tutoring for struggling readers in grades 1-3 (Clay, 2005, Pinnell, Lyons, DeFord, Bryk, & Seltzer, 1994; Pinnell, Fried, & Estice, 1990). Another successful program is *Success for All*, which has a track record of providing successful school-wide tutoring interventions for students at-risk of reading difficulties (Slavin, Madden, Karweit, Livermon, & Dolan, 1990).

Programs such as these, and others, use literacy practices that are supported by research evidence and that have been shown to work well for at-risk readers. Additionally, with new initiatives such as Response to Instruction (RTI), which is a part of the 2004 reauthorization of the Individuals with Disabilities Act, research indicates that it is possible to substantially reduce the number of students classified as learning disabled. This legislation, according to Johnston (2011) and Allington (2010) enables schools to (a) provide increasingly intensive tiered instruction to help ensure that students having difficulty learning to read are provided with the requisite expert instruction, and (b) identify students who continue to have reading difficulties after receiving intensive reading instruction. The most commonly used form of RTI has three tiers of instruction ranging from conventional classroom reading instruction (Tier 1), to supplementary expert instruction delivered in small group settings (Tier 2), to targeted instruction provided in one-on-one tutorial settings for students most in need of reading assistance.

Since the enactment of the IDEA legislation, there has been a great deal of interest within schools and districts to put in place tiers of instruction systems aimed at significantly reducing the number of students experiencing reading difficulties. To address the needs of students who are most at-risk of reading difficulties (i.e., those who are in the third tier of instruction), many schools have put in place various types of extended-day programs depending on their needs and resources. Allington (2012) describes four of the most commonly used extended school-day designs as follows:

1) *School-based remedial assistance with expert reading instruction*. In this design, eligible students work with reading and/or special education teachers for an hour or more after school to accelerate literacy development.

2) *School-based tutoring with trained community volunteers, high school, or college students*. Designs such as this often consist of only once or twice weekly sessions, although some do provide daily instructional support.

3) *School-based homework help/child care/recreation with paraprofessional or volunteer support*. In this design, eligible students receive mostly homework assistance with corresponding recreational activities.

4) *Community-based homework help/child care/recreation*. There are actually fewer school-based than community-based after school programs currently operating. These programs, which are similar to school-based programs, are sponsored by organizations such as YMCA, Boys and Girls Clubs, churches, and other community groups (Allington, 2012, pp. 179-180).

These designs vary in terms of target audience, staffing expertise, instructional focus, and intensity of instruction. Research on the effectiveness of these program designs is rather mixed. For instance, in one study, Wasik and Slavin (1993) found that programs using certified teachers resulted in significantly higher gains than programs using non-certified staff. However, other researchers (e.g., Davidson & Koppenhaver, 1993; Inverzini Rosemary, Juel, & Richards, 1997; Wasik, 1998) found that programs using non-certified personnel were as effective as those using certified teachers. The key to success in these programs, according to Allington (2012), appears to be related to "providing non-certified personnel with strong training, structured tutorials, and ongoing supervision" (p. 181).

Have reading programs been equally effective for nearly all at-risk readers?

Looking beyond the reading programs that have been shown to be effective in helping at-risk readers catch up to their grade level, a growing number of literacy researchers and teacher educators have expressed concern that effective programs have not always been comparably successful for all at-risk readers, especially for those children who come from ethnically diverse and economically disadvantaged backgrounds (e.g., Au, 2011; Cochran-Smith, 2004; Compton-Lilly, 2007, 2009, 2011; Gorski, 2013; Ladson-Billings, 2009). These children, they argue, are often overrepresented among at-risk readers in schools. They bring a vast range of abilities, practices and life experiences that are often quite different from the practices and experiences they encounter at school.

In light of these circumstances, one should not assume that a program or intervention that proves to be effectiveness for one group of students will be equally effective for other groups of readers. While serving as a Reading Recovery teacher trainer in a high-poverty school in Wisconsin, Compton-Lilly (2011) examined how well the program serves African American children, including children who did not complete the 20-week interventions or who were otherwise hindered by policies, which disadvantaged children who bring diverse life experiences to Reading Recovery classrooms. She found that there was a 20% difference in success rates between African American children and European American children when we considered all the children served in Reading Recovery. These authors argue that recognizing the funds of knowledge these children bring to school is an important first step to helping them become successful readers and writers. In his book, *Reaching and Teaching Students in Poverty: Strategies for Erasing the Opportunity Gap*, Gorski (2013) provides an insightful review of the research and instructional practices that hold promise for working with these children around literacy, an excellent analysis of why economic inequities exist and persist among public school students, and an overview of practical classroom-tested guidance for teachers and leaders who care enough to make a difference.

The Present Study

We collaborated with an elementary school on the design of a supplemental or tier 3 before-school tutoring program, with the goal of enhancing the reading skills of a small pilot group of at-risk, first-grade students. Our proposed supplemental reading intervention program is fairly similar to the second program design described above in that it uses trained pre-service teachers and provides a highly structured and closely supervised reading intervention program.

The overall purpose of the study was to evaluate the effectiveness of this supplemental reading intervention on students' reading achievement outcomes. Specifically, we were interested in finding out whether participation in this supplementary tutoring program results in significant improvements in students' reading achievement as measured by scores obtained on nationally normed measure of reading proficiency.

Instructional/Research Setting

We conducted the pilot study in a local area elementary school located in a mid-size city in the southwestern United States. Opened in 2000, the target school is a Fine Arts magnet school operating within a large Independent School District (approximately 18,000 students) in the southwestern United States. The school has 675 students in kindergarten through 5th grade. Student population is 36% African American, 32% Hispanic, and 27% White with an Economically Disadvantaged rate of 65%. Forty-two full-time teachers and 20 support staff serve these students. The school has five first grade classrooms with an average of 24 students per classroom. Of the 120 or so students in first grade, about 30-40% were designated as needing assistance in reading.

Study Participants

Participants in this case study consisted of 12 first grade at-risk readers who entered first grade with low levels of reading and writing skills. Students were selected for participation in the study based on teacher recommendations and student performance on district benchmark assessments data using the Texas Primary Reading Inventory test battery, which placed them in the lowest performing quartile among all first grade students in the school. Of the 12 students identified for tutoring, 5 were Hispanic (4 males, 1 female) and 7 were African American (6 males, 1 female). Although none of the students were identified as having a reading or learning disability, one student repeated first grade, one was identified as having attention deficit hyperactivity, and one was an English learner. Additional information about student demographics is provided in Table 1. In the section below, we provide a brief profile of each of the student participants.

J.A. is seven years old. He likes to draw and enjoys spending time with his family. His mother works at a day care, and he spends a lot of time with his Granny. He enjoys mysteries and scary stories with monsters, and he likes playing math games at school. In his tutoring sessions, it is often difficult for him to focus and he gets off-task easily if he is not actively engaged in an activity. Initially, he had low confidence in his reading ability, but has visibly gained confidence through this program.

Six-year-old **V.A.** enjoys playing at the playground. She lives at home with her mom, dad, and sisters. V.A prefers short, funny books, particularly about animals. At home, she does not have any books in her room but her sisters read chapter books so they have a few books around. During her tutorial sessions, V.A struggles to read fluently. She began tutoring with low confidence in reading and was very shy, but quickly gained confidence through her reading and enjoys choosing the book she would like to read during tutoring sessions.

L.B. is six years old. She spends a great deal of time drawing, playing games on the computer, and socializing with her siblings. She currently lives with her grandmother and aunt and is the youngest of her many siblings. L.B says she enjoys reading, particularly animal books, picture books, and funny stories. At school, she enjoys playing games, especially math games. At home, her grandmother occasionally reads to her before bedtime. During tutoring sessions, L.B struggles to stay engaged. Her confidence level in reading is high during familiar reading, and is hesitant to attempt reading through more difficult texts.

E.C. is seven years. He loves playing soccer. At school, E.C enjoys learning, playing with his best friend at recess, learning math, and participating in science activities. He says he likes to read about mysteries, and books about super heroes, animals, sports, and cars. At home, he reads mostly with his Granny but there aren't any books at his house. E.C struggles mainly with phonemic awareness skills such as blending sounds. Overall, E.C has a desire to learn and finds reading enjoyable.

Seven-year-old **N.C**. enjoys playing with his friends, and playing games on the computer. He claims that he loves to read, no matter the genre, and likes to write stories. At home, there aren't many books to read except in his Mimi's room. During his tutoring sessions, it is evident that he struggles to read words and sentences at age-appropriate levels fluently, which poses problems for him when trying to understand what he reads.

H.C. is seven years old. His favorite activities include going to waterparks, watching T.V. and playing video games. H.C lives with his mom but visits his dad (non-English speaking) on the weekend. He also has an older brother who is at the same elementary school. He likes to be able to read books that are funny. H.C says that his mother sometimes reads to him at home on occasion. In tutoring sessions, H.C requires glasses to read, which he often forgets, and he struggles with word decoding and reading fluency. His confidence in his reading is low.

J.H. is seven years old. He likes playing on the computer and with video games. His favorite character is the Hulk. J.H prefers reading non-fiction and books about superheroes and he reads with his mom in the evening with the few books he has at home. He gets easily distracted during tutoring sessions and finds it hard to focus on what he is reading.

Six-year-old **M.J**. enjoys football, Spiderman, and playing with his younger siblings. He lives with his mom, who is an accountant, and his dad, a policeman, and has an older brother in 3rd grade and a newborn brother. In his tutoring sessions, M.J. has trouble making connections between letter sounds in words longer than five letters and struggles with comprehension when reading grade level materials.

J.M. is eight years old. He likes watching T.V. and drawing, and has interests in bugs and animals. He lives with his mom and has older sisters who are also in elementary school. J.M. rides the bus to school and is sometimes late to school because of it. He likes his tutor and looks forward to coming to school as a result.

I.O. is seven years old. He likes playing on the playground, tag, and soccer. He lives at home with his parents and two brothers. I.O. prefers to read books about spiders, soccer, animals, cars, and super heroes. At home, he reads with his parents and brothers and has several Dr. Seuss books in the house. I.O. often arrives late to his tutoring sessions, which reduces the amount of time his tutor gets to spend with him.

C.R. is six years old who enjoys drawing pictures and learning about fish. At home, he reads mostly with his mother. While they do not have books in his house, his mother frequently reads magazines and his grandmother reads newspapers. C.R. prefers to read books about sports and super heroes. He has excellent attendance at school and likes getting help in reading.

E.S. is a six-year-old boy who struggled with reading but has made great progress throughout the year. He enjoys engaging in literacy conversations and reading books at home with his siblings, parents, aunts, uncles, and grandparents. He reports that his living room only has two or three books, although he has access to magazines at home and he like computer-reading games. He also likes math and science because he thinks they are cool and with reading, the pictures in the books let him know what he is reading. During tutoring sessions, he especially likes to read about sports, superheroes, animals, car and trucks, book in series, and funny stories.

Instructional Framework

For purposes of this study, we developed a research-based instructional framework to help us organize and manage instruction. Our literacy instruction framework incorporates established instructional design characteristics in terms of content, organization, and management of literacy instruction. It also takes into account student needs as well as the needs of our tutors. For instance, we wanted to design a framework that incorporates the literacy needs of our target group of students with respect to early language and literacy skills. In addition, we developed a flexible the framework to enable our tutors to adapt lessons that are relatively easy to implement and evaluate, and to enables us to closely supervise and monitor the degree to which components of the framework are implemented as intended to the extent possible.

Our instructional framework includes three key components including (a) a 20-minute reading or re-reading of an easy or familiar text, (b) a 20-minute shared or interactive reading of a self-selected text, and (c) a 20-minute interactive writing segment targeting specific writing skills and strategies. Together, the three components of the framework take approximately 50-55 minutes to complete. Appendix A provides a descriptive outline of the key components of the framework with sample activities.

Consistent with the recommendations delineated in the newly developed Publishers' Criteria for the Common Core State Standards in English Language Arts and Literacy, Grades K–2 (Coleman & Pimentel, 2012), all curriculum materials used when tutoring our target students have three important characteristics: first, students have access to a mix of literary and informational texts that vary in terms of topics, length, complexity, and genres. We wanted to help ensure that students have opportunities to read texts that are rich and accessible on their own and with others in order to help build their knowledge, experience, and enjoyment of reading. Second, we made a concerted effort to select materials that appeal to students' interests and needs. We wanted to provide students access to interesting reading materials that motivate them to read so that they can do so independently in and outside of school. Third, we provided a sufficient number of leveled reading materials during each tutoring session so as to enable students to read texts they can read on their own as well as texts that are more complex that they may be able to read with tutor guidance. Tutors introduce higher-level texts and present them through read-alouds, shared readings, and other tutor-assisted strategies.

Instructional Delivery

Pre-service teachers pursuing degrees at a local university received training as literacy tutors and delivered the tutoring lessons three times a week for a period of 10 weeks during the regular fall and spring semesters of one school year. Tutor training took place as a part of a semester-long reading assessment and instruction course that pre-service teacher candidates complete in partial fulfillment of the requirements of a Bachelor's degree in elementary education. This course is designed to help pre-service teachers strengthen expertise in identifying students' reading difficulties and designing instruction aimed at helping students improve their early grade reading skills. The course includes a supervised field experience, which requires teacher candidates to apply what they learn about reading assessment and instruction in a local elementary school setting.

Tutor Training

Our approach to preparing effective tutors is guided by the ecological context of our at-risk participating readers. We challenge our tutors to think critically and reflectively about productive ways of supporting the reading and writing development of these students, many of whom come to school with low levels of literacy. We want our tutors to think carefully about why they do what they do before rather than after thinking about what they do and how they do it. When tutors explore the underlying reasons why a particular child entered first grade with lower than expected reading skills, for instance not knowing all the letters of the alphabet, they are more likely to be constructively responsive to the needs of that child. They are also likely to become more thoughtful and reflective about their teaching.

We planned and implemented our tutor training in three closely integrated steps. These steps include an initial training phase during the first four weeks of the semester, a 30-minute debriefing phase, which takes place immediately following each tutoring session, and an individual consultation phase, which takes place throughout the semester depending on the needs of individual tutors.

During the first four weeks of the semester, tutors receive instruction in approximately 1.5 hours twice a week for four weeks. During this time, tutors also learn about the school setting in which tutoring takes place, meet with the school principal and teachers, and learn about the students they will be assigned to tutor.

During the tutor training sessions, instruction and coaching typically consists of close reading and discussion of evidence-based literacy practices, using assessment data to inform instruction, and organizing instruction in tutorial settings using a common instructional framework. Supporting materials for the first component include a mix of readings such as *"What at-risk readers need"* (Allington, 2011),*"FAD: Filtering, analyzing, and diagnosing reading difficulties"* (Mokhtari, Niederhauser, Beschorner, & Edwards, 2011), and "*What's a tutor to do?* (Roller, 2006). During the debriefing sessions, tutors engage in a guided tutoring lesson study and reflection with a focus on what worked well, and what needs improvements, as well as sharing of ideas and resources. Individual consultation is initiated either by the instructor or by the student depending on perceived needs. Tutors keep a reflective journal, which often serves as a source for identifying challenges, questions, or issues for discussion.

Research Design

Doing research in real-world school settings is complex. Our study takes place in a school setting with ecological constraints, which makes it not feasible or ethical to conduct randomized controlled experiments, the 'gold standard' for establishing what works. For purposes of our study, because our target student participants were identified as at-risk readers with a unique set of needs and backgrounds, we were not interested in just finding out whether our intervention generally works for these students as a group, for doing so does little to tell us under what circumstances it does or does not work. More importantly, our goal was to use the data obtained from the intervention to better understand the conditions under which individual children, not just groups, succeed or fail to learn to read.

We collected student and tutor assessment data at various times during the year to help us determine the promise of the literacy tutoring intervention for producing the outcomes it is intended to produce. We collected pre- and post- assessment data for all first grade students in the school. Doing so enabled us to make comparisons in reading achievement outcomes across three groups of students: At-risk readers who needed and received reading assistance (At-Risk Tutored), at-risk readers who needed but did not receive supplemental reading instruction (At-Risk Non-Tutored), and typically developing readers who did not need nor receive supplemental reading assistance (Typically Developing Peers). Because we combined two approaches in our research design, (we collected data multiple times and examine student performance across groups), our design can best be described as a quasi-independent group design with one equivalent group and one non-equivalent group design.

When selecting our non-tutored comparison group, we used propensity score matching, a quasi-experimental technique, recommended by Guo & Fraser (2010) to find students similar to the intervention students in terms of their background characteristics, using information from school databases such as gender, ethnicity, school-administered reading benchmark test scores, participation in free or reduced lunch, and other demographic characteristics. We also randomly selected a group of typically developing readers from the rest of first grade students who did not need assistance in reading.

Data Collection

We assessed students' reading achievement outcomes at the beginning and end of the school year using the *Gates-MacGinitie Reading test* (MacGinitie & MacGinitie, 2004). This test is a standardized nationally norm-referenced, general reading ability test, which assesses foundational literacy skills including vocabulary and reading comprehension skills. It is commonly used test of reading ability with adequate technical adequacy as measured by reported reliability (reliability coefficients range from .89 to .93 for vocabulary and .87 to .94 for comprehension) and validity data (high correlations reported for studies correlating Gates reading tests with other tests of reading comprehension).

In order to determine the extent to which tutors adhered to the key elements of the instructional framework, we collected fidelity of implementation data in two ways. First, tutors completed a fidelity of lesson implementation protocol for each of the lessons they delivered (See Appendix A). Fidelity of lesson implementation consisted of checking off lesson components completed as-is, modified, or not completed. Second, two members of our team observed each tutor for at least one lesson on two occasions during the school year using a lesson observation protocol (See Appendix B). These data helped us monitor and assess the functioning of the tutoring lessons in action, collect implementation fidelity data, and make the necessary adjustments in the design of the intervention so as to enhance its overall functioning. We reviewed 100% of the lesson implementation fidelity forms completed by tutors and sought reliability for coding the observation protocols made by two members of our team for each tutor observed. An examination of the tutor fidelity of lesson implementation indicated that our tutors implemented lessons as intended or with slight adaptations about 85% percent of the time. Inter-rater reliability between two lesson observers was 89%.

Data Analysis

We collected student and tutor assessment data throughout the year to help us determine the promise of the literacy tutoring intervention for producing the outcomes it is intended to produce. In an attempt to determine whether the reading intervention had an impact on at-risk tutored students, we analyzed the data obtained in three different yet complementary ways. First, we examined the amount of tutoring time each student received over the course of the school year, and we analyzed the progress in reading proficiency achieved by students individually and as a group from fall to spring taking into account the total tutoring time invested.

Second, we examined the progress achieved by tutored students in comparison to a matched group of at-risk non-tutored peers and in comparison to all typically developing first grade peers in the same school. We analyzed the data obtained by using Analysis of Covariance (ANCOVA), which enabled us to control for students' initial level of reading ability using students' Gates-MacGinitie Fall semester scores as a covariate, and provided us with a cleaner measure of effect of our instructional intervention.

Finally, with a relatively small number of students in our study, and in light of the fact that students' reading development changes over time, but not necessarily in the same way or at the same rate, we reviewed each student's growth individually, and examined student performance in relation to national proficiency standards so as to determine whether the student is on track to reach proficiency, or remains at-risk of reading failure.

Results

The results obtained are presented in three complementary ways: As the amount of tutoring time each student received over the course of the school year, the progress in reading proficiency achieved by students individually and as a group from fall to spring taking into account the total tutoring time, the progress achieved by tutored students in comparison to a matched group of at-risk non-tutored peers and typically developing first grade peers in the same school. Please note that our data analyses are based on a total of 10 participating at-risk students since one of the students moved in the middle of the year, and one student completed the program but did not participate in all assessments. These results are presented in Tables 1-2 and Figures 1. Table 1 presents group demographics as well as the amount of time spent by the at-risk first grade students who received tutoring the fall and spring semesters of the school year.

Table 1. *Student Demographic Profiles*

	At-Risk Tutored (*n*=12)	At-Risk Non-Tutored (*n*=11)	Typical Peers (*n*=10)
Mean Age (SD)	6.67 (.65)	6.72 (.64)	6.5 (.53)
Gender			
Male	8	7	6
Female	4	4	4
Ethnicity			
African-American	7	6	2
Caucasian	0	1	6
Hispanic	5	4	3
Special Need			
English Learner	1	1	0
Special Needs	1	1	0

How much one-on-one instructional time did each at-risk student receive over the course of the school year?

As Table 1 shows, the ten first graders received an average of 17.85 hours of instructional time during the fall semester and 28.95 hours of tutoring during the spring semester for a total average of 47.33 hours (SD=4.58) of tutoring or roughly 2840 minutes. Individual tutoring time ranged from a low of 42 hours (2520 minutes) to a high of 53.95 (3195 minutes). The average tutoring time our students received falls within the recommended 44-80 hours range of instruction needed to substantially reduce the incidence of reading failure in a school system by accelerating at-risk students' reading proficiency to average levels of performance (Allington, 2012; Clay, 2005).

What proportion of tutored students made sufficient progress in reading proficiency after 47 hours of one-on-one reading instruction?

An examination of the students individual reading progress data show that 9 out of 10 of the at-risk tutored students achieved significantly higher extended scale scores on the

Gates-MacGinitie test in the spring 2013 when compared to their performance on the same test in the fall 2012. These data are fairly consistent with literacy tutoring research suggesting that when tutored by a well-trained tutor, the average at-risk reader should be expected to read more proficiently than approximately 75 percent of the untutored students in the control group (Institute of Education Sciences, 2003).

Are at-risk tutored first graders learning beginning reading skills at about the growth rate one would expect?

At the end of first grade, the main concern is whether each student has developed adequate beginning reading skills to get a good start in reading. To determine whether a student has made good gain during grade 1, assessment experts recommend using National Curve Equivalents (NCEs), which are normalized standard scores with a mean of 50 and a standard deviation of 21.06. NCEs measure progress in reading by describing a student's position within the norming group at successive times during the year or grade levels. As a general rule of thumb, experts agree that a student who maintains about the same NCE from fall to spring or earns a total score on a test level less than 7 NCEs has not changed relative to the achievement of students in the norming group. A student with an NCE score of 50 is roughly at grade level. Table 2 displays the average NCE scores of students in our three groups. An examination of these data indicates that at-risk students made gains of nearly 20 NCEs between fall and spring semesters while the scores of at-risk non-tutored students actually declined by nearly two points from 30.1 to 28.6. Typically developing first grade peers gained nearly 18 points from fall to spring. While it is evident that the NCE growth scores of the at-risk group of students were lower than typically developing peers, the reading progress made provide evidence that the reading intervention has made a significant difference in the reading skills of at-risk tutors.

Table 2. *Comparison of Reading Growth Rate of At-Risk Tutored, At-Risk No-Tutored, and Typically Developing Non-Tutored First Grade Peers*

Measures	**Fall** M (SD)	**Winter** M (SD)	**Spring** M (SD)
Gates-MacGinitie Reading Test (NCE)*			
At-Risk Tutored Peers	21.75 (14.0)	37.9 (14.36)	40.3 (18.7)
At-Risk Non-Tutored Peers	30.1 (15.7)	30.8 (19.8)	28.6 (19.3)
Typically Developing Peers	60.0 (26.6)	78.4 (22.19)	77.67 (21.2)

* NCE= National Curve Equivalent

How proficiently did at-risk tutored students read when compared to at-risk non-tutored peers and to typically developing first grade students in the same school?

Table 3 presents the means and standard deviations pertaining to the reading progress made by the three groups of students at three points in time during the school year (i.e., Fall, Winter, & Spring). Table 3 also includes the means that were adjusted for the effects of the covariate. Following Field (2009), we used these means rather than the original means to more accurately interpret the group differences reflected in our ANCOVA analysis.

Table 3. *Comparison of Reading Proficiency of At-Risk Tutored, At-Risk Non-Tutored, and Typically Developing Non-Tutored First Grade Peers*

Measures	**Fall** M (SD)	**Winter** M (SD)	**Spring** M (SD)	
Gates-MacGinitie Reading Test (ESS)*			**Original Means**	**Adjusted Means****
At-Risk Tutored Peers (12.6)	288.3 (22.6)	343.0 (24.9)	371.7 (43.5)	393.83
At-Risk Non-Tutored Peers (11.1)	306.4 (28.2)	329.1 (35.5)	342.3 (43.9)	351.09
Typically Developing Peers (14.8)	367.3 (56.7)	433.1 (54.8)	456.6 (50.3)	421.19

Notes: *ESS=Extended Scale Score; ** Means Adjusted For The Effect Of The Covariate

Using a test of Between-Subject effects, we found an overall significant group effect of our reading intervention after controlling for initial group differences in reading ability, $F(2,26) = 8.002$, $p = .002$). An examination of the adjusted means (and contrasts) for the three groups shows that the at-risk tutored students had higher adjusted means after 47 hours of one-on-one reading instruction (M= 393.83; SD= 12.6) than did their at-risk matched peers who did not receive any tutoring (M= 351.09; SD= 11.1). However, as Table 2 shows, the adjusted means of the typically developing peers (M= 421.19; SD= 14.8) was higher than both the at-risk tutored non-tutored. We verified these results using the Sidak Corrected post hoc pairwise comparisons among the three group means and found that the at-risk tutored students outperformed the at-risk non-tutored students, ($p = .04$). The post hoc tests further showed that the typically developing students outperformed the at-risk non-tutored students ($p = .001$) but not the at-risk tutored students ($p = .218$) although they had a higher adjusted mean score. Figures 1 provide a visual depiction of these differences.

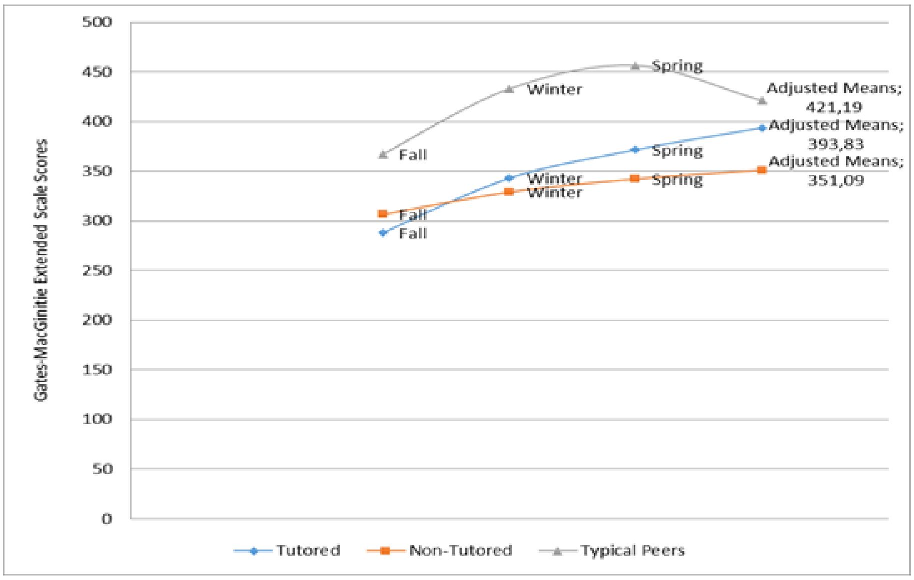


Figure 1. *Comparison of Reading Growth of At-Risk Tutored, At-Risk Non-Tutored, & Typically Developing Non-Tutored Peers*

Discussion

The findings of this study are encouraging. Our pilot quasi experiment generally shows that it is indeed possible to significantly advance the early grade reading achievement outcomes of at-risk first grade students when we provide them with a sufficient amount of individualized instruction by well-trained tutors. We analyzed the results using a suite of procedures to determine whether our pilot intervention achieved its intended outcomes, and functioned well in a local area school setting.

Taken together, our findings revealed several promising outcomes. First, we found that 9 of 10 of the at-risk tutored students achieved significantly higher extended scale scores on the Gates-MacGinitie test at the end of the intervention when compared to their performance on the same test before the intervention. These data are consistent with literacy tutoring research suggesting that when tutored by a well-trained tutor, the average at-risk reader should be expected to read more proficiently than approximately 75 percent of the untutored students in the control group (Institute of Education Sciences, 2003).

Second, we found that students who received tutoring read more proficiently after 47 hours of instruction when measured by Gates-MacGinitie, a standardized norm-referenced test of reading ability. These students read more proficiently at the end of the intervention than did non-tutored students in a matched group of first grade peers in the same school. However, when compared with the performance of typically developing readers, we found that these students received lower average reading proficiency scores than typically developing peers in the same school, although this difference was not significantly different.

Third, we examined student performance to determine whether at-risk tutored first graders' beginning reading skills were at or about the growth rate one would expect. Using average NCE scores of students in our three groups of readers, we found that at-risk students made gains of nearly 20 NCEs between fall and spring semesters while the scores of at-risk non-tutored students actually declined by nearly two points from 30.1 to 28.6. Typically developing first grade peers gained nearly 18 points from fall to spring of the same year. While it is evident that the NCE growth scores of the at-risk group of students were lower than typically developing peers, the reading progress made provide evidence that the reading intervention has made a significant difference in the reading skills of at-risk tutors.

When considering all aspects of this pilot study, we find that while these results are quite encouraging, especially in light of literacy research documenting the impact of one-on-one tutoring by qualified tutors of at-risk readers in grades 1-3, an achievement gap remains when comparing the reading proficiency of tutored students to that of their typically developing first grade peers who did not need extra assistance in reading. This is not too surprising since our students entered first grade with a significantly larger gap in literacy achievement than did typically developing peers. Closing this reading achievement gap will take additional instructional time in the form of one-on-one and/or small group instruction, which will help accelerate to average levels of performance the progress of children who show early signs of reading difficulty. Some of these children's reading progress typically falls within the lowest 20% of the enrollment in similar school settings.

In light of these findings, it is worth noting that in order to help maintain the progress at-risk students made during the school year, opportunities need to be provided for them to read and write during the summer months. Research has shown that students in primary and elementary grades lose much of their reading ability when they do not read during the summer months when school is not in session. This reading loss has been shown to affect these students' reading performance when they return to school in the fall. Research has also shown that students from lower socio-economic backgrounds suffer greater summer reading loss than do students from upper socio-economic levels. The likelihood of summer reading loss is therefore more real for students who are poor and who have poorly developed language skills (Allington & McGill-Franzen, 2003).

Taking a rearview mirror look at our yearlong journey, we learned valuable lessons from this pilot study that helped inform and direct the necessary revisions and refinements of the intervention with the goal of building the school's capacity to support the literacy development of at-risk readers so that they can catch up with their typically developing peers. We are eager to share these lessons with primary and elementary grade reading teachers and school leaders, who may be interested in putting in place reading intervention programs aimed at improving reading performance among underachieving students in the early grades.

Lessons Learned

In assessing what worked well for us in this pilot program, we attribute the improvement in reading proficiency among our target students to five closely inter-related contributors. First, we wanted to identify students who entered school with low literacy skills fairly early during the year and in first grade. Even though the school had underachieving readers in second through fifth grade, we wanted to design a reading intervention program that specifically targets students entering first grade. Investing in first grade reading development will is more likely to have an impact on reducing the incidence of reading failure in subsequent grades.

Second, drawing from research and practices documenting what has worked particularly well in tutoring programs such as Reading Recovery, Success for All, and others, we wanted to provide these students with a sufficient dose of intensive instruction that is likely to result in improved reading achievement outcomes for these students. Although we know that the amount of instructional time needed to help close the achievement gap varies a great deal depending on student needs, we used the recommended margin of 44-80 hours of instruction as a general target (e.g., Allington, 2012) in designing our reading intervention for these at-risk students.

Third, we worked conscientiously to help ensure that our tutors, who were pre-service teacher candidates, were effectively prepared for their tutoring roles and responsibilities. As we indicated in the tutor training section above, our training focused on the challenges, issues, and questions that our target students were experiencing at that time. Tutors received intensive training during the first four weeks of the semester on evidence-based literacy practices, using assessment data to inform instruction, and organizing instruction in tutorial settings using a common instructional framework. This training was followed by daily debriefing sessions, which took place immediately following each tutoring session, and individual consultation, which took place throughout the semester depending on the needs of individual tutors. This model of tutor preparation was experiential and focused primarily on the school context in which tutoring took place.

Finally, we attribute the impact of this pilot reading intervention to our school-university collaborative relationship, which proved essential in terms of identifying students in need of reading assistance, access to pertinent assessment data, providing an environment conducive to tutoring sessions, and enabling excellent communication among tutors, parents, and the first grade teachers of these students.

Acknowledgement

The Anderson-Vukelja-Wright Endowment Fund provided support for the design and implementation of this project.

• • •

References

Allington, R. L., (2011). What At-Risk Readers Need. *Best of Educational Leadership*, 68, 40-45.

Allington, R., and Gabriel, R. (2012). Every child, every day. *Educational Leadership*, 69 (6), 10-15.

Allington, R., and McGill-Franzen, A. (2003). The Impact of Summer Setback on the Reading Achievement Gap. *The Phi Delta Kappan*, 85(1), 68-75

Allington, R.L. (2010). *Essential readings on struggling readers.* Newark, DE: International Reading Association.

Allington, R.L. (2012). *What really matters for struggling readers: Designing research-based programs*. New York: Longman.

Au, K. (2011). *Literacy achievement and diversity: Keys to success for students, teachers, and schools*. New York, NY: Teachers College Press.

Clay, M. M. (2005). *Literacy lessons designed for individuals: Part one, why? when? how?* Auckland, New Zealand: Heinemann.

Cochran-Smith, M. (2004). *Walking the road: Race, diversity, and social justice in teacher education.* New York, NY: Teachers College Press.

Coleman, D., & Pimentel, S. (2012). *Revised Publishers' Criteria for the Common Core State Standards in English Language Arts and Literacy, Grades K–2*. The National Governors Association Center for Best Practices and the Council of Chief State School Officers. Washington, DC.

Compton-Lilly, C.F. (2007). *Re-Reading families: The literate lives of urban children four years later*. New York, NY: Teachers College Press.

Compton-Lilly, C.F. (2009). Literacy practices of African American children: Three case studies. In G. Liu (Eds.), *Multicultural families, home literacies, and mainstream schooling*, (pp. 29 - 49). Charlotte, NC: Information Age Publishing Company.

Compton-Lilly, C.F. (2011). Counting the uncounted: African American students in one reading intervention. *Journal of Early Childhood Literacy*. 11(1), 3 - 24.

Davidson, J. & Koppenhaver, D. (1993). *Adolescent literacy: What works and why.* New York: Garland.

Field, A. (2009). *Discovering statistics using SPSS*. London, England: Sage Publications.

Gorski, P. (2013). *Reaching and Teaching Students in Poverty: Strategies for Erasing the Opportunity Gap*. New York: Teachers College Press.

Guo, S. & Fraser, M.W. (2010). *Propensity score analysis: Statistical methods and applications. Los Angeles*: Sage Publications.

Holdaway, D. (1979). *The foundations of literacy.* Portsmouth, NH: Heinemann

Institute of Education Sciences (2003). *Identifying and implementing educational practices supported by rigorous evidence: A user friendly guide*. Washington, DC: U.S. Department of Education.

Invernizzi, M., Rosemary, C. A., Juel, C., & Richards, H. (1997). At-risk readers and community volunteers: A three year perspective. *Journal of the Scientific Studies of Reading, 3,* 277-300.

Johnston, P.H. (2011). Response to intervention in literacy: Problems and possibilities. *The Elementary School Journal*, 111 (4), 511-534.

Ladson-Billings, G. (2009). *The dreamkeepers: Successful teachers of African American children.* San Francisco, CA: Jossey-Bass.

MacGinitie, W. H., MacGinitie, R. K., Maria, K., Dreyer, L. G., & Hughes, K. E. (2000). *Gates-MacGinite Reading Tests* (4th Edition). Rolling Meadows, IL. Riverside Publishing.

Mokhtari, K., Niederhauser, N., Beschorner, B., & Edwards, P. (2011). F.A.D.: A basic procedure for filtering, analyzing, and diagnosing students' reading & writing difficulties. *The Reading Teacher*, 64 (8), 631-635.

National Center for Education Statistics (2011). *The Nation's Report Card: Reading 2011* (NCES 2012–457). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, Washington, D.C.

Pinnell, G. S., Fried, M. D., & Estice, R. M. (1990). Reading Recovery: Learning how to make a difference. *The Reading Teacher*, *43*(4), 282–295.

Pinnell, G. S., Lyons, C. A., DeFord, D. E., Bryk, A. S., & Seltzer, M. (1994). Comparing instructional models for the literacy education of high-risk first graders. *Reading Research Quarterly*, 29(1), 8–39.

Roller, C. M. (1998). *So… what's a tutor to do*? Newark, DE: International Reading Association.

Slavin, R. E., Madden, N. A., Karweit, N. L., Livermon, B. J., & Dolan, L. (1990). Success for all: First-year outcomes of a comprehensive plan for reforming urban education. *American Education Research Journal*, *27*(2), 255–278.

Snow, C.E., Burns, M.S., & Griffin, P. (eds.) (1998). *Preventing reading difficulties in young children*. Washington, D.C: National Academy Press.

Taylor, B. M., Critchley, C., Paulsen, K., MacDonald, K., & Miron, H. (2002). *Learning to teach an early reading intervention program through Internet-supported professional development*. Retrieved from EIR® website: http://www.earlyinterventioninreading.com/pdfs/taylor_research2.pdf.

Taylor, B.M. (2007). *The what and the how of good classroom reading instruction in the elementary grades.* Minneapolis, MN: University of Minnesota Center for Reading Research.

Taylor, B.M., Peterson, D. S., Pearson, P.D., & Rodriguez, M.C. (2010). Looking inside classrooms: Reflecting on the "how" as well as the "what" in effective reading instruction. In R.L Allington, *Essential readings on struggling learners*. Newark, DE: International Reading Association.

Trelease, J. (2013). *The new read-aloud handbook*. New York, NY: Penguin.

Wasik, B. A. (1998). Volunteer tutoring programs in reading: A review. *Reading Research Quarterly, 33,* 266-292.

Wasik, B. A., & Slavin, R. E. (1993). Preventing early reading failure with one-to-one tutoring: A review of five programs. *Reading Research Quarterly*, *28*(2), 178–20.

APPENDIX A

LITERACY LESSON FRAMEWORK

Lesson Component	**Description**	**Time Frame**
Reading Familiar Text	Session begins by having the child re-read a familiar text with the goal of building reading fluency and boosting self-confidence (Clay, 1995; Pinnell, Fried, & Estice, 1990). Tutor conducts a running record as the child reads.	15 minutes
2.5 Minute Break		
Interactive Reading	Shared book reading and writing is interactive experience whereby the child participates in guided reading and writing activities, thus allowing them to learn about how language works and to see themselves as readers and writers (Snow, Griffin, & Snow, 1998; Holdaway, 1979).	20 minutes
2.5 Minute Break		
Interactive Writing	Session concludes with the tutor modeling reading of (and writing about) a challenging new text. This is an opportunity for the child to read and write about texts that are rich and accessible in terms of content so as to help build their knowledge, experience, and enjoyment of reading and writing (Trelease, 2006).	20 minutes

APPENDIX B

TUTOR SELF-RATING OF LESSON IMPLEMENTATION FIDELITY PROTOCOL

Please take a few minutes following each lesson to share insights regarding lesson implementation.

Tutor: ____________________ **Start Time:** _____ a.m. p.m.

Tutee:____________________ **End Time:** _____a.m. p.m.

	Implemented	**Comments**
Familiar Reading (15 Minutes)	As is Modified No	
2.5 Minute Break		
Interactive Reading (20 Minutes)	As is Modified No	
2.5 Minute Break		
Interactive Writing (20 Minutes)	As is Modified No	

Open-Ended Comments:

1. Please describe aspects of this lesson that worked particularly well.

2. Please describe aspects of this lesson that did not work well.

3. Please describe what you will do next to address the aspects of the lesson that did not work as planned.

APPENDIX C

LESSON FIDELITY OF IMPLEMENTATION OBSERVATION PROTOCOL

Observer: ____________________

Tutor: ________________ **Start Time:** _____ a.m. p.m.

Tutee: ________________ **End Time:** _____ a.m. p.m.

	Implemented	Comments
Familiar Reading (15 Minutes)	As is / Modified / No	
2.5 Minute Break		
Interactive Reading (20 Minutes)	As is / Modified / No	
2.5 Minute Break		
Interactive Writing (20 Minutes)	As is / Modified / No	

Overall Lesson Quality: ☐
3= Outstanding
2= Fair
1= Needs improvement

Overall Lesson Pacing: ☐
3= Too fast
2= About right
1= Too slow

Open-Ended Comments:

1. Describe aspects of the lesson observed that are particularly strong.

2. Describe aspects of the lesson observed in need of improvement.

3. Describe recommendations for improvement.

International Electronic Journal of Elementary Education, 2015, 7(3), 301-318.

A Study of Geometry Content Knowledge of Elementary Preservice Teachers

Fatma ASLAN-TUTAK *
Bogazici University, Turkey

Thomasenia Lott ADAMS
University of Florida, USA

Received: 3 March 2015 / Revised: 17 May 2015 / Accepted: 27 May 2015

Abstract

The purpose of this research is to examine preservice elementary school teachers' geometry learning as investigated by both qualitative and quantitative methods. For the qualitative investigation, narrative analysis and thematic analysis methods were used. The findings of narrative analysis indicated two main kinds of stories: as a learner and as a beginning teacher. The thematic analysis findings yield to three themes: history of learning geometry, perceptions about geometry, effective geometry instructional practices. The findings informed the quantitative investigation on geometry content knowledge for the case of quadrilaterals. During the second phase of the study, 102 participants who enrolled in the methods course completed pre and post test of teachers' geometry content knowledge. Treatment group participants (n=54) received series of activities (geometry activities and student work analysis) focusing on quadrilaterals, and control group participants (n=48) received traditional instruction. Repeated measures ANOVA results showed a significant change in treatment group participants' geometry content knowledge. The mixed ANOVA results indicated a significant main effect of knowledge but no significant interaction between geometry content knowledge and grouping. Even though treatment group participants' geometry content knowledge growth was significant, the difference between treatment group and control group participants' growth in geometry content knowledge was not significant. This study informs mathematics teacher education in three important areas; limited knowledge of preservice teachers' geometry content knowledge, integrating mathematics content and the context of teaching into methods course, and use of student work with preservice teachers.

Keywords: Teachers' mathematics content knowledge, geometry, mathematical knowledge for teaching, elementary school preservice teachers.

* Fatma ASLAN-TUTAK, Secondary School Science and Mathematics Education, Faculty of Eductaion, No:510, Bogazici University, Phone: +90 212 3594610, E-Mail: fatma.tutak@boun.edu.tr

ISSN:1307-9298

www.iejee.com

Christiana was excited to go to her first class in university after transferring from the community college of the same city. She was hopeful to be a good teacher. On her way to mathematics course, she remembered her mathematics teachers throughout her education. She regretted that none of them had inspired her to learn mathematics. She wanted to have a new start with this university because she cared about her future students from then. She wanted to learn mathematics that she previously avoided, and she wanted to know everything about teaching mathematics to be the good teacher that she never had.

Christiana is one of the participants who told her story of learning geometry for the study discussed in this manuscript. This article reports a two-phase research study which integrated qualitative and quantitative research methods to study preservice elementary teachers' geometry learning and their geometry content knowledge. The first phase of the study was the qualitative investigation to understand preservice teachers' geometry learning. Integration of results from the study of effective geometry learning experiences of preservice teachers and teacher education literature, the researcher developed series of activities for a mathematics methods course. Those activities used as the intervention for the quasi-experimental quantitative phase with purpose of improving the geometry content knowledge of preservice teachers. This article will report (i) the qualitative investigation on preservice elementary teachers' geometry learning, (ii) the development of the activities as a result of that investigation, and (iii) studying the effect of the activities by a quantitative investigation.

Introduction

The most commonly accepted definition of teacher knowledge was given by Shulman (1986, 1987), who developed a model of teacher knowledge. His definition is consisted of three types of teacher knowledge: subject matter knowledge (SMK), pedagogical content knowledge (PCK) and curriculum knowledge. SMK refers to knowledge base of the content one is teaching, such as mathematics. PCK "goes beyond knowledge of subject matter per se to the dimensions of subject matter knowledge for teaching" (Shulman, 1986, p. 9). PCK is the type of knowledge that distinguishes the work of a teacher from the work of a scientist. The third knowledge type, curriculum knowledge, addresses effective use of curriculum materials and teachers' familiarity with other subjects studied.

Among these knowledge types, subject matter knowledge stands out as a point of interest for teacher education. Brown and Borko (1992) asserted that preservice teachers' limited mathematics content knowledge may hinder their pedagogical training. Also, other studies have shown that lack of subject matter knowledge affects teacher's methods of teaching (e.g. Carpenter, Fennema, Peterson & Carey, 1988; Leinhardt & Smith, 1985). Carpenter and his colleagues (1988) emphasized that subject matter knowledge of a teacher heavily affects the teachers' use of the pedagogical tools. Even though SMK is emphasized greatly in teacher knowledge, the type of mathematics is not just to solve problems mathematically correct (Ball, 1988, 1990a, 1990b; Leinhardt and Smith, 1985; Owens, 1987; Post, Harel, Behr, & Lesh, 1988; Steinberg, Haymore, & Marks, 1985).

In the mathematics education field, Ball and a group of researchers developed mathematical knowledge for teaching (MKT) as following the Shulman's model for teacher knowledge. MKT model addresses how a teacher uses mathematics for teaching while emphasizing the importance of mathematics knowledge in teaching settings (Ball, 2000). According to MKT model, there are six domains of teacher's content knowledge which can be categorized under Shulman's different types of knowledge (Ball, Thames & Phelps, 2008). There are three domains under subject matter knowledge: common content knowledge (CCK, mathematics knowledge not unique to teaching), specialized content knowledge (SCK, mathematics knowledge unique to teaching), and horizon content knowledge (knowledge of mathematics throughout the curriculum). Also, there are three domains under pedagogical content knowledge: knowledge of content and students (KCS, interaction of knowledge of mathematics and students' mathematical conceptions), knowledge of content and teaching (KCT, interaction of knowledge of mathematics and teaching methods), and knowledge of content and curriculum (interaction of knowledge of mathematics and mathematics curriculum). This model was used wide spread in mathematics education research. There were also efforts to adapt or improve the model according to different contexts. For the international comparison study on preservice mathematics teachers (Tatto et al., 2008), MKT model and the teacher knowledge instrument inspired TEDS-M study. Furthermore, Mathematics Teachers' Specialized Knowledge (MTSK) was developed by Carillo and his colleagues in order to strengthen the connection to classroom practices (Carrillo, Climent, Contreras, & Muñoz-Catalán, 2013).

Content knowledge of teachers is important for every subject including geometry, one of the most applicable topics to daily life, yet, which is often a neglected topic in the curriculum. There are several studies on teachers' knowledge of mathematics focused on topics such as fractions (Carpenter et. al, 1988) or numbers and operations (Ball, 1990; Ma, 1999). The limited number of research projects focused on knowledge of geometry for teaching concludes that beginning teachers are not equipped with necessary content and pedagogical content knowledge of geometry, and it is important to address this issue in teacher education (Browning, Edson, Kimani, Aslan-Tutak, 2014; Jones, 2000; Swafford, Jones, & Thornton, 1997).

Studies on geometry content knowledge of teachers emphasized the lack of teachers' knowledge, especially the beginning teachers (Barrantes & Blanco, 2006; Chinnappan, Nason, & Lawson, 1996; Jacobson & Lehrer, 2000; Lampert, 1988; Leikin, Berman, & Zaslavsky, 2000). "Teachers are expected to teach geometry when they are likely to have done little geometry themselves since they were in secondary school, and possible little even then." (Jones, 2000, p. 110).

Therefore, this study is an effort to improve mathematics teacher education in geometry. This study's most important characteristic is to understand preservice teachers' needs and strengths from their perspective in order to address their geometry learning needs to enhance their geometry content knowledge. There were four research questions, first two to address geometry learning (studied by qualitative research methods) and the last two to address geometry content knowledge of preservice teachers (studied by quantitative research methods):

1. What are participating preservice elementary teachers' perceptions of geometry in elementary school who were enrolled in mathematics methods course?
2. What are the perceptions of participating preservice elementary teachers on effective instructional strategies to promote their knowledge of geometry in the mathematics methods courses?
3. Does use of geometry activities focused on quadrilaterals with analysis of student work influence preservice elementary teachers' geometry content knowledge?
4. Is there a significant difference in geometry content knowledge between preservice teachers who received regular mathematics methods course instruction and preservice teachers who received experimental mathematics methods course instruction?

Method

This study was conducted in a mathematics methods course at a large southeastern research university for predominantly middle-class, white, female elementary school preservice teachers in the U.S. Students begin their unified elementary education program in their junior year and usually they take the methods course in their senior year. This course plays an important role in preservice teachers' education because it is the only mathematics methods course for elementary school preservice teachers.

Before taking the mathematics methods course, elementary school preservice teachers are required to take three mathematics courses, two general mathematics courses (e.g. calculus) and one content course for elementary teachers. The mathematics content course addresses mathematics concepts for elementary school level whereas the mathematics methods course is designed to build the future teachers' pedagogical tools for teaching mathematics. Even though the recommendation of this order is given, some students take methods course and the content course at the same time or some take methods course before the content course. The research reported in this manuscript is multi-stage, using mixed research methods. The research was conducted in three phases, Figure 1. Due to nature of research itself, the manuscript is also organized in three sections.

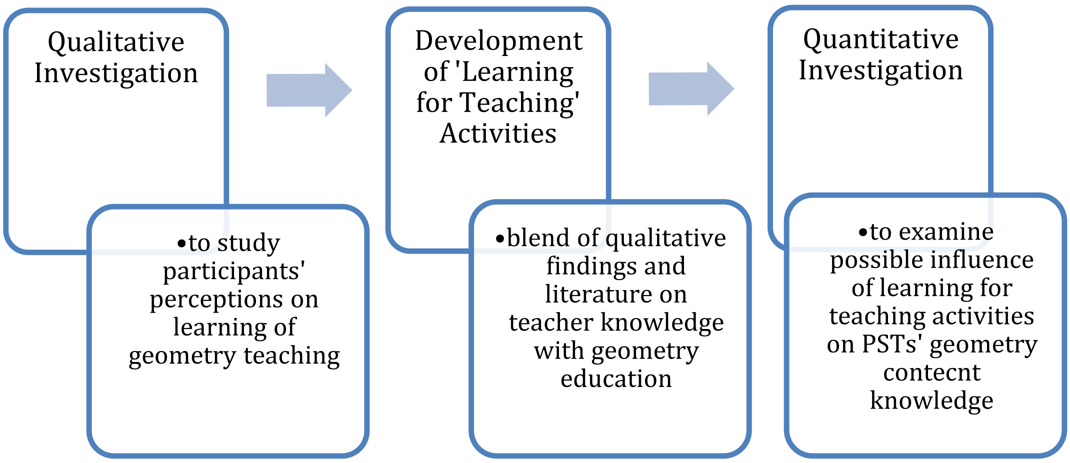


Figure 1. Three phases of the study.

Phase I: Qualitative investigation

The theoretical perspective of this investigation is constructivism. Hatch (2002) addressed the quest of a constructivist researcher as "individual constructions of reality compose the knowledge of interest to constructivist researcher" (p.15). For this research, in order to study preservice teachers' geometry knowledge, first, the researcher listened preservice teachers about their experiences of learning of geometry and their perspective on means to improve their geometry content knowledge. It was necessary to address preservice teachers' constructions of geometry learning in order to be able to develop tasks to improve their geometry content knowledge.

The goal of the qualitative investigation was to understand preservice teachers' geometry learning especially in methods courses. The findings of the first phase informed teacher education practice to develop geometry activities for methods course to be used in the third phase (quantitative investigation). Christiana, Emma and Liz (pseudonyms), the volunteered participants, were preservice elementary school teachers who were enrolled in the methods course. There was one participant from each three sections of the course. The researcher was not offering methods course at the time of qualitative investigation. In this study, only Liz took the content course before methods course. The other two participants, Christiana and Emma were planning to take it the following semester.

Qualitative data sources

The data collection methods included individual interviews with the participants, observations of geometry instruction in each section of the course for two weeks, and the collection of materials used during the geometry instructions. Field notes were taken during the observations. Also, copies of the instructional materials (handouts and transparencies) and student presentations were collected. The primary purpose of the observations and the artifact collection was to capture content preparation for the geometry learning process of preservice elementary teachers in order to provide triangulation for the interview data. The primary data source for this investigation was individual interviews. The purpose of the interviews was to study preservice elementary teachers' stories of learning geometry. The 45-60 minutes long interviews were conducted after the participants received geometry instruction in methods course.

The narrative interview protocol was used which was designed to be semi-structured and open-ended. The narrative interviews are tailored to intrigue story telling from participants through open-ended questions or probes (Reissman, 1993, 2000). The mostly suggested narrative interview probes are "Tell me about…" (Reissman, 1993, 2000). For this study, some of the interview questions were "Tell me about your geometry learning before college" or "Tell me about geometry instruction in methods course". Another important feature of narrative interviews is that the researcher accepts the leading role of the participant because the participant is the knowledge holder (Bruner, 1990; Reissman, 2000).

Qualitative data analysis

The data analysis in this qualitative investigation was focused on participants' experiences of geometry learning. The interviews, the source of the data analysis, were analyzed for both narrative and non-narrative forms. In addition to structural analysis of the preservice teachers' stories (Labov, 1972) thematic analysis (Coffey & Atkinson, 1996) of both narrative and non-narrative data was used.

Individuals may use narratives for meaning making in addition to using them for sharing their experiences in stories (McAdams, 1993; Reissman, 1993). Grbich (2007) identified research settings which might be addressed by narrative analysis as "those that explore either the structure of narratives or the specific experiences of particular events, e.g. marriage breakdown; finding out information which is life changing; undergoing social/medical procedures; or participating in particular programmes" (p. 124). In the case of teacher learning, narrative analysis may be used to study professional development experiences of in-service teachers or preservice teachers in teacher education programs. Also, Cortazzi (1993) suggests that teachers may prefer to discuss their learning and their knowledge through stories. Teachers' narratives have been used in teacher education and teacher development in various context such as Carter (1993), Clandinin and Connelly (1996), Cortazzi (1993), Doyle and Carter (2003), and Elbaz (1991). Sarac (2012) used semi-structured narrative interviews in order to categorize teachers in terms of their teaching self-efficacy levels. "Researchers have come to appreciate that teachers' stories offer a wealth of information about their individual identities and classroom experiences" (Lloyd, 2006, p. 58).

The stories told by participants during the interviews were analyzed by using narrative analysis method of Labov (1972). According to Labov (1972, 1982) a narrative has a structure and a sequence. If a narrative is fully formed, it has six components; abstract (AB; summary of the narrative), orientation (OR; time, place people etc.), complicating action (CA; sequence, turning points, crisis, content), resolution (RE; resolution of events, crisis), evaluation (EV; interpretation), and coda (CO; narrative ends and turn back to listener). The structure of the narratives, produced by participants, gives insights about how they perceive their experiences in methods course. The order of the components may change, while some of the components may be absent from stories. Table 1 provides an example of Labov's narrative coding on the story of a participant about her content course experiences.

Table 1. *An example of narrative coding*

this is really where it gets tricky	**AB**
I did not like the teacher (.)	
I don't think she (.) taught the class very well (.)	
she already had a notebook of notes	**OR**
you have for the rest of the year and	
she followed it very strictly and	
if you would ask a question	**CA**
she would just say either come and see me after class or	
she would like no its right there you are supposed to get it and	
she kept going on so our questions were unanswered and	**RE**
I really didn't like that and	**EV**
she just she just didn't have a lot of patience and	

***AB**: abstract, **OR**: orientation, **CA**: complicating action, **RE**: resolution, **EV**: evaluation, **CO**: coda

In addition to structural analysis of narratives, thematic analysis (Coffey & Atkinson, 1996) was used and the whole interviews were coded. Literature supports using other analysis methods in addition to narrative analysis in order to deepen the analysis of the rich data (Lloyd, 2005, 2006; Reissman, 1993, Robichaux, 2002). In addition to the narratives, participants talked about geometry learning and teaching in non-narrative form. The open codes from interviews yielded into themes to inform the researchers about effective geometry learning experiences for the participants.

Qualitative findings

The findings section of the qualitative investigation is organized as narrative analysis findings and thematic analysis findings. There were two main kinds of stories with sub headings emerged from participants' narratives: stories as a learner and stories as a beginning teacher. The thematic analysis yielded three themes from preservice teachers' geometry learning: history of learning geometry, perceptions about geometry, effective geometry instruction approaches.

Narrative analysis findings

The participants told stories about their learning experiences of geometry from two different perspectives, as a learner (K-12 and college mathematics courses) and as a beginning teacher (college mathematics courses and mathematics methods course). Even though participants experienced the methods course as beginning teachers, all three of the participants emphasized the role of their history of learning geometry as a student on their experiences in the methods course as beginning teachers. Therefore, the stories from both perspectives (learner and beginning teacher) are important to study in order to understand preservice elementary mathematics teachers' geometry learning in mathematics methods course.

The resolution (RE) and evaluation (EV) components of the narratives reflected the focus of the participants as a learner or as a beginning teacher in addition to participants' perceptions about geometry learning. In addition to RE and EV components, the OR component informed the researcher about the settings, time and characteristics of the instructions in the narratives. One interesting result from orientation competent of narratives from all three participants was that all of the narratives were about courses that participants took. The participants did not tell any story outside the formal education environment, even though geometry has strong connection with real life applications.

Stories as a learner. The stories of learning geometry with an emphasis as a learner were stressed usually in K-12 education and in college mathematics courses. For example, Emma mentioned about the geometry course that she took in 9th grade and her perceptions about that class. "we did I remember making bridges and to see how much weight popsicles sticks with different shapes and angles how to build together stuff and I didn't love it (.) I didn't really take another I don't think we really did a lot of geometry".

On the other hand, for college mathematics courses participants told stories from both perspectives, as a learner and as a beginning teacher. All three participants told stories from the mathematics courses they took and they expressed that those courses were as a review of their high school knowledge. Only Christiana expressed that one of the college mathematics course was effective in her learning. Due to her weak mathematics background from high school and community college, she expressed that she learned more mathematics in that college mathematics course than in high school mathematics courses. "in topics of mathematics it went through everything it went through like statistics geometry algebra stuff that I never heard of truth tables".

The stories told about the mathematics content course for elementary school teachers is limited because only one participant, Liz, took the course before the methods course. The stories of Liz from that course reflected her concerns about the limited mathematics learning and through the absence of the connection of that course to her teaching career. Liz was concerned that she could not learn enough. Also, her story of geometry learning in that class expressed that the content was confusing for her. "we reviewed the properties of parallelograms what makes them rhombus and stuff a drawing of each of these things but she really lightly touched on them like on their characteristics she did not spend a lot of time on talking about distinctions so sometimes we would be confused wait so is this this (emphasized) or is this that (emphasized) she goes like that its that and just keep going and so its never stop I didn't get it".

In spite of her focus in methods course as a beginning teacher Liz expressed that her experiences as a student in the methods course was more effective than the content course for learning mathematics. "even if math was challenging she [methods course instructor] makes it so that get it and she would go back and explain it in other way…what I like this class a lot better than [the content course] I like concrete models and I like different ways of looking at the same thing".

Stories as a learner. Since the participants took their college mathematics courses after they decided to be teacher, they had the consciousness about learning mathematics in those courses as a teacher. The beginning teacher aspect, being able to relate college education into elementary classroom teaching, was briefly expressed in the narratives from mathematics courses. An example of the beginning teacher aspect is Liz's perspective on mathematics content course. Even though her priority in that course was to learn mathematics as a student, she had thoughts about ways to transfer the presented knowledge into her teaching. This was another frustration for her. "we would do a lattice addition and multiplication and to me that was confusing I don't know if I would wanna go teach the kids that specific method so it was hard".

Most of the stories as a beginning teacher took place in methods course. Only one participant (Liz) was satisfied with her learning in the methods course. The other two participants expressed their frustration as the lack of the mathematical discussions and connection between content and the teaching methods (Emma), and the misguided flow of the course by moving to the more difficult topics before discussing easier topics (Christiana).

Christiana stressed her difficulty in the class due to lack of discussion on easier geometry topics before doing activities with more advanced topics. Even though 3-D shapes would not be considered as advanced topics in geometry, Christiana had difficulty understanding those concepts. "I think more complex level of geometry [3-D shapes such as polyhedra and related vocabulary] is definitely good to teach in college courses but I think you have to start at the basics [2-D shapes and related vocabulary] because not everybody is on the same page". As the order of topics discussed was a concern for Christiana, Emma's concern was the lack of connection between mathematics topics and teaching methods. She expressed that she gathered valuable activities to use in the classroom however she never experienced discussions on those activities. "I prefer to like do some of the mathematics problems and then learn hands on kind of things and have her explain like why she taught us that way or why she did certain things specific".

Thematic analysis findings

From the thematic analyses, three themes, history of geometry learning, perceptions about geometry, effective geometry instructional approaches were emerged. It is important to note that, even though narrative analysis and thematic analysis findings are reported separately, they are embedded in each other. For example, there are both stories as learners and as beginning teacher for participants' perceptions about geometry.

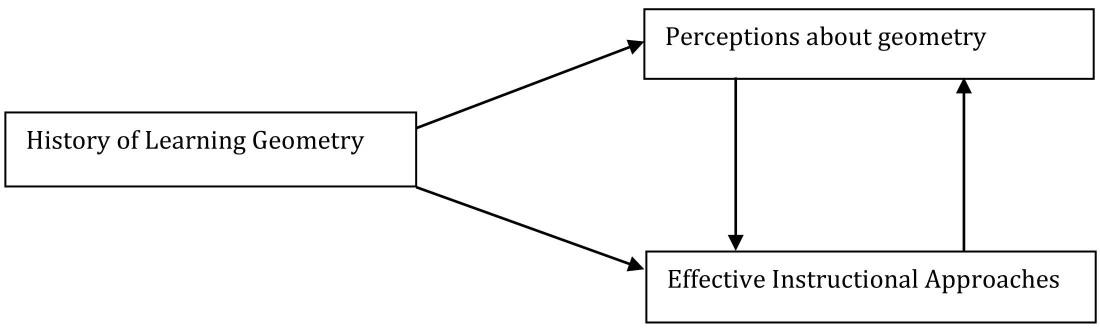


Figure 2. Thematic analysis findings

History of geometry learning. Preservice teachers bring their perceptions, beliefs and learning experiences into the teacher education programs. All three of the participants mentioned how they learned geometry and their teachers especially before college. Their background in geometry played very important role in their learning in college courses especially the methods course. All of them stressed the emphasis on algebraic topics in K-12 education with limited learning opportunities of geometry. They took one geometry course in high school, and they all expressed being dissatisfied with that course. Emma expressed that even though her teacher was "*the easy teacher*" and the teacher did "*fun activities*" she did not like the course. When she was asked about the reasons why she did not like class, she expressed that there were more of the characteristics of a course than having fun to make it effective. Emma brought her geometry perceptions into the methods course, and she expected the instructor to be able to provide content discussions in addition to pedagogical preparation.

Another aspect of participants' history of learning geometry is the focus on algebraic topics in K-12 education. They all perceive geometry as being different than mathematics because they have the perception of mathematics as algebraic topics. Christiana stated that "*I didn't have any clue about geometry [in high school] and then I went to community college and I had to take intro to algebra and then college algebra so it was back to algebra again which algebra is pretty easy I started doing algebra 7th grade middle school so I didn't even think I had to touch*". Their history of learning geometry indeed affects their perceptions about geometry and learning geometry which also reflects on their perceptions about the effective instructional approaches to teach and learn geometry.

Perceptions about geometry. All the participants recognized the importance of visualization in geometry. Participants expressed geometry as a study of shapes and measurement features related to the shapes (such as area). Indeed, the participants gave only 2-D shapes rather than 3-D shapes as examples. For example Christiana thought 3-D geometry as an advanced topic. Some other important topics of geometry such as transformation were not mentioned by any of the participants. Their limited experiences with geometry resulted in distorted perception of geometry. "*for me geometry is basically studying shapes and dimensions and how things fit in things that what I think about geometry*" (Liz).

Furthermore, when participants were asked about effective geometry instruction methods they expressed that effective practices for geometry were different than for the ones for other topics of mathematics. Participants perceived geometry learning different than learning algebraic topics. They preferred to have more real life examples and visual representations for geometry while for other topics learning the formula through direct instruction would be enough.

Effective geometry instruction approaches. The participants addressed the practices and activities which helped their understanding and learning of geometry especially in methods course. The mostly emphasized instruction approach was addressing geometry topics for elementary school (content) before studying instructional aspects of those topics (pedagogical content). Participants stressed their need to study the concepts first in order to be able to understand pedagogical aspects of the topics. Even tough, participants perceived college mathematics courses as reviews before the methods course, because those reviews did not provide desired in-depth geometry understanding for elementary school, they were expecting more content preparation from methods course. As addressed before, only Liz was satisfied from the methods course in terms of receiving both content and pedagogical content preparation. She experienced "*understanding how a child would see it a child cannot grasp this way but he can understand that way*".

All three of the participants addressed practicing content before the pedagogical aspects of geometry. Especially Emma emphasized content preparation because she thought the pedagogical preparation effective yet she had difficulty to grasp the ideas. Emma stated that she could not relate to the activities for elementary school classroom because they discussed only the pedagogical aspect of the activities. "*she [the instructor] gave us a lot of tricks and fun activities and then she actually taught well but she is still I* *guess like besides that it was more like stuff to do in your class we never actually did mathematics problems I prefer to like do some of the mathematics problems and then learn hands on kind of things and have her explain like why she taught us that way or why she did certain things specific*". She wanted to experience the activities as her students in order to be able to understand students process of learning. Even though Christiana experienced content discussions she could not relate the geometry activities to the pedagogical skills. "*we went through a lot of example we used a lot of manipulatives but I don't know a lot of time that's like how to use that in classroom how is this gonna help for future instruction*".

The second aspect of content preparation in the methods course was to progress from easier to more difficult topics in geometry. Christiana's instructor was providing content preparation before the pedagogical discussions, yet she stated that the instruction was not effective in her learning because the discussed geometry topics were advanced for her. All three participants expressed the need to study basic geometry topics (such as 2-D shapes) before advanced geometry topics because they were aware of their limited knowledge of geometry. Christiana especially felt the disproportion because of her limited geometry background. *"[talking about polyhedra and vocabulary for 3-D shapes] I think this is what we went over and that's things I never heard before ... I learned new words like I never heard hexahedrons stuff and I didn't even know what was it six sides 3-D shape never heard some of this stuff in my other geometry class*". Then she stressed the importance of starting from basic in order to address students from different background.

In addition to content preparation in the methods course, the participants addressed some instructional practices that were helpful in their geometry learning. The highly stressed feature of an effective geometry instruction was the use of visual aids such as drawing on the board or on the overhead projector, using of manipulatives such as geoboard. All three of the participants mentioned help of visual drawings in their geometry learning. In the methods course, they experienced geometry manipulatives more than drawings. Especially Liz was very glad to be introduced to the manipulatives in teaching geometry. "*she [the instructor] had the geoboards with rubber band those are really good way of thinking of simpler shapes*".

Another effective instructional practice emphasized by all three of the participants was working in groups. They addressed the supportive feature of group work in classroom activities. Students in groups would explain some topics to each other without asking the instructor. Due to her difficulties with content, Christiana was receiving help from her group members. She could not direct her questions to the instructor so she expressed that "*we do a lot of group work and so there is a lot of interaction going on and that's really helpful*".

Qualitative conclusions

The findings of this investigation may inform mathematics teacher educators on some important issues in preservice elementary teacher education who have limited experience of learning to teach mathematics. Participants of the study took only one mathematics teaching course and there were only two classes (each 3 hours) for geometry teaching. The most important result of this study is participating preservice elementary teachers' lack of geometry knowledge as reported by them. All the participants were very enthusiastic in teaching in elementary school. They all stressed the importance of professionalism to be an effective teacher. They all favour hands-on and meaningful teaching in mathematics. However, they still felt that they were not ready to teach mathematics in elementary school. They expressed that they need to learn more before they began teaching. In other words, good intentions are not enough to be good teachers (Borko et al., 1992). Borko stressed that often teacher education programs do not support preservice teachers in their learning in order to transform them to knowledgeable teachers.

Preservice teachers were aware of their lack of content knowledge. Their limited knowledge in turn affected their learning pedagogical aspects of teaching (Fennema & Franke, 1992). Even though preservice teachers should have been prepared content wise before the methods course, many of them were not equipped with enough content knowledge to focus on pedagogical content preparation. They stressed that content preparation before the methods course was not addressing in-depth understanding for elementary geometry (Ball et al., 2008).

According to participants, the methods course for preservice elementary teachers should provide content knowledge in addition to the pedagogical content knowledge. Even though methods course instructors addressed content, they used different instructional approaches. Among the three participants, only one of them reported an effective integration of content and pedagogy preparation in the methods course. The findings of this investigation stress two important characteristics of studying mathematics content in methods course. First, the mathematics topics should be accessible to the preservice teachers. The difficulty of mathematics topics should be from easier to the more advanced topics. The teacher educators should aim to address the diverse mathematical background that the preservice teachers bring in the classroom. The second characteristic of an effective content preparation in a methods course is to provide the content blended with the pedagogical aspects. In other words, the mathematics content should be addressed in the context of teaching. Participants were aware of that the primary purpose of methods course was not mathematics, but pedagogy. However, without any content discussion the preservice teachers were having trouble relating to the pedagogical examples.

It is important to note that the type of content knowledge that has been asked by participating preservice teachers was not college level mathematics, but mathematics that they would be teaching. They did not feel confident about knowing elementary school geometry for teaching it meaningfully (Browning et al, 2014). This type of knowledge is the type of content knowledge that Ball et al. (2008) called as specialized content knowledge (SCK). In studying SCK, Ball et al. (2008) stressed the importance of using mathematics in the context of teaching because SCK is the mathematics knowledge for only teachers to use in teaching.

Therefore, teacher educators who work in similar setting as in this investigation should address the content needs of preservice teachers in methods courses too. Furthermore, it is important to discuss content in the context of teaching. Compared to their algebra experiences, they have very limited experiences with geometry which results in limited geometry knowledge. In the light of qualitative investigation findings and literature on teacher education, the researchers developed a series of activities to improve elementary school preservice teachers' geometry content knowledge for teaching.

Phase II: Development of Learning for Geometry Teaching Activities

The synthesis of the results from the qualitative investigation, methods course resources such as Van de Walle (2007), and the literature on preservice teacher education yielded to learning for geometry teaching activities on quadrilaterals as an intervention to be used in third phase, quantitative investigation. The findings of participating preservice teachers' experiences in the explained setting were emerged in six principles of activity development.

- *There is a need to address content in addition to pedagogical practices in the methods course.*

- *Preservice teachers' reported their lack of knowledge in 2-D geometry topics especially in quadrilaterals.*
- *Preservice teachers stressed that, in methods course, discussion of content before the discussions of pedagogical practices would improve their learning.*
- *Preservice teachers expressed the importance of the flow of instruction from easier topics to more advanced topics due to various backgrounds among them.*
- *Preservice teachers addressed the effectiveness of using visual aids such as drawings for their geometry learning.*
- *Preservice teachers explained that various forms of activities such as small group works in addition to individual work were helpful in their learning.*

The activities can be grouped in two; geometry activities and pedagogical activity (analyzing student work). These activities will be described below in detail but interested reader may access whole activities from Aslan-Tutak (2009).

Geometry activities. Geometry activities were grouped as: *sorting shapes*, *attributes of shapes*, and *classification of polygons*. The first activity was a sorting activity in which the participants (in pairs) sorted 33 cut-out shapes in groups according to their properties. The groups of shapes were concave, convex, hexagons, pentagons, triangles, quadrilateral, kite, trapezoid, parallelogram, rectangle, rhombus, and square (at least three of each category). When the participants were sorting shapes they experienced defining characteristics of the shapes and the relationship between them. As a result of this activity, the participants worked individually to developed definitions of those shapes.

For the second group of activity (attributes of shapes) participants worked in pairs to study 10 groups of figures. The participants were asked to determine which figure in a group did not belong to others. In other words, the participants had to find a figure which did not share the common characteristics with other three figures. Participants were encouraged to find more than one answer for each group. For example, in a group of four figures, one of them did not belong to others because it was concave while another one did not belong to other three because it was not a quadrilateral. The goal of this activity was for preservice teachers to practice the characteristics of shapes in an open-ended problem solving activity while discussing the relationship between the shapes.

For the last group of activities (classification of polygons) the participants worked in small groups to develop a visual representation (tree diagram) demonstrating the relationships between the polygons especially the quadrilaterals. Participants were given vocabulary (in alphabetical order) to fill the empty spots in the visual representation. The vocabulary were concave, convex, hexagon, kite, parallelogram, pentagon, polygon, quadrilateral, rectangle, rhombus, square, trapezoid and triangle. After the completion of the diagram, participants answered a set of true-false questions based on the diagram. Some of the examples of true-false questions were "All pentagons are regular" and "Only some trapezoids are parallelograms".

In addition to individual characteristics of the activities, the combination of them provided coherence. Participants worked individually, in pairs and small groups. At the end of the each activity, the facilitator led whole class discussions on the topics while providing the right answers. The participants experienced geometry topics with visual representations such as cut-out shapes. Also, the activities progressed through van Hiele geometric thinking levels. Participants began with level 0 and level 1 activities (e.g. sorting) and finished with a level 2 activities (e.g. true-false statements). Therefore, the activities reflected suggestions from both literature and qualitative results.

Analyzing student work. One of the possible designs to provide content in the context of teaching is using student work to analyze what students know and what they are learning.

Using student work has been widely accepted by teacher educators to improve teacher learning and instructional practices (Lampert & Ball, 1998; Little, 2004; McGuire, 2013; Smith 2003). Furthermore, using student work to facilitate teacher learning may result in teachers' deeper content knowledge (Franke & Kazemi, 2001; Kazemi & Franke, 2004). The authors discussed that by analyzing student work, teachers may be forced to think deeply and elaborate on mathematics knowledge while they are trying to understand what students did. "Making sense of children's strategies could be an indirect way for teachers to wrestle with the mathematical issues themselves" (p. 7).

Kazemi and Franke (2004) suggested that the student work to be used in professional development to improve teachers' content knowledge should be challenging in terms of students' errors. With this purpose, the researchers collected student work from elementary schools with mathematically struggling students. As a result of collaboration between the researchers and elementary school teachers, the geometry worksheet for classrooms use was designed. The worksheet consisted of open-ended questions for definitions of some geometry shapes (polygons and quadrilaterals) and 10 figures to be determined if they are certain quadrilaterals with mathematical explanations. To be used in the research, six students' worksheets which were providing most challenging geometry ideas were selected.

During the treatment, the participants were given a protocol to analyze student work. The protocol was developed by suggestions from several resources (E. Kazemi, personal communication, August 17, 2008; NCTM, 2006). First, participants completed the worksheet as students and then they received sample student work. In pairs, the participants discussed what the student did, what the student knew (and misconceptions), what they would ask the student in order to learn more about the student's knowledge of geometry. Then, in small groups (two pairs), participants discussed what they would do to teach these concepts to the student and how they would address the student misconceptions. There were six groups of four participants, and each group discussed a different student's work. For the whole class discussion, the facilitator asked groups to share their student work and their discussions.

Phase III: Quantitative investigation

The third phase of this research is the quantitative investigation which aimed to study effect of using the developed learning to teach geometry treatment on preservice teachers' geometry content knowledge. At the time of implementation, there were three instructors for four sections of the methods course in which one hundred and seven students were enrolled and 102 of them volunteered to participate in the study. All the participants were female. Two of the sections were selected as treatment and other two were selected as control groups. All the instructors were teaching geometry for two weeks (three hour class for each week) during the last third of the semester. Because the focus of this research was geometry, the intervention had to be conducted during the time of geometry instruction of each section. This time restriction is also a rationale of this research. The purpose of the research was to investigate practices that will work for preservice teachers with similar settings and limited opportunities to learn mathematics teaching. Furthermore, as a precaution to avoid researcher bias, another trained instructor delivered the intervention tasks. She was not teaching at the time of this study but she had valuable experience with the student population of this course. One of the researchers was also present in the class during the intervention for observation.

The instrument to measure change in participants' geometry content knowledge, Content Knowledge for Teaching Mathematics Measures (CKT-M Measures)[1], was developed by Learning Mathematics for Teaching (LMT) at University of Michigan. LMT can be seen as continuum of research on mathematics knowledge for teaching (MKT) which was discussed in literature review. The validity and reliability of the instrument was studied by experts from different backgrounds (Ball et al., 2008; Hill et al., 2004, 2008). The instrument addresses the majority of mathematics topics under three categories: number and operations (K-6 and 6-8), patterns functions and algebra (K-6 and 6-8), and geometry (3-8). For the study mentioned in this article, the researchers used only geometry section. Two parallel forms of the geometry section of the test were administered as pre- and post-test. The pre-test consisted of 19 multiple choice questions in 8 stems. The post-test consisted of 23 multiple choice questions in 8 stems.

Quantitative data collection and analysis

Participants completed the CKT-M Measures geometry test one week before geometry instruction. For next two weeks (three hours of instruction for each) they received the geometry instruction and the following week they completed the post-test. In order to address third and fourth research questions (geometry knowledge growth of treatment group and any difference of knowledge growth between treatment and control group) two different analysis methods, repeated measures ANOVA and mixed ANOVA, were used, respectively.

Quantitative results

In order to study geometry knowledge growth of treatment group, repeated measures ANOVA was used. Results showed a significant change in participants' geometry content knowledge, $F(1, 49) = 16.08$, $p<.001$, $R^2 = .25$, eta^2 = .25. This indicates statistically significant positive change in treatment group participants' geometry content knowledge. A mixed ANOVA method of analysis was conducted to study whether there was difference of knowledge growth between treatment and control groups. Results indicated a significant main effect of time $F(1, 91) = 28.38$, $p<.001$ but there was no significant interaction between time and grouping (treatment/control), $F(1, 91) = .21$, $p=.646$. The results showed that geometry knowledge of participants was increased significantly; however the grouping did not have effect on participants' knowledge growth. It can be concluded that even though treatment group participants' geometry content knowledge growth was significant, the difference between treatment group and control group participants' growth in geometry content knowledge was not significant.

Quantitative conclusion

The analysis of growth in treatment group can be interpreted as that use of the activities developed in phase two, from the qualitative investigation, resulted in significant increase in preservice teachers' geometry content knowledge. Even though treatment group participants' increase was more than the increase of control group participants, the difference was not statistically significant. One of the limitations of this investigation to explain non-significant difference between gain scores of participants would be the limited authority in control group instruction. One of the researchers observed the control group instruction. The control group instructor who has certain experience with preservice elementary teachers used an instruction based on elementary school curriculum. Therefore, some common characteristics of these two instructions can be identified as use of learning activities in the context of teaching especially closely linked to the classroom and use of the topic of quadrilaterals. Furthermore, intervention of six hour instruction may not be long enough to provide detectable statistical difference between groups' changes in content knowledge. Because it was not possible to spend more time for geometry in this course, this research can be expended with a similar design for a longer period of time in a different setting.

In a study of middle and secondary school teachers' geometry content knowledge, Fostering Geometric Thinking (FGT), Driscoll and his colleagues used content activities and analysis of student work with in-service teachers (Driscoll et al., 2009). This study showed significant difference between control group teachers who did not receive any professional development and treatment group teachers who received 20-week long intervention. The intervention was designed to provide geometry content experiences for teachers and analysis of student work from teachers own classroom.

Comparison of FGT study and this study reveals other limitations such as selection of the student work. Using student work with preservice teachers might not be as effective as using them with in-service teachers. This study provides a new topic of discussion on using student work with teachers. The effects of using student work might vary in the context of preservice or in-service teacher education. In the case of in-service teachers, participants first experience teaching the materials and then analyze student work. On the other hand, in the case of preservice teachers, participants only experience the materials as a student without teaching them. Therefore, this study might start the discussions such that the role of actual teaching of the materials before analyzing student work.

The results of the study also provide some suggestions for mathematics methods courses. Mathematics teacher educators should consider examining the settings especially the participants and their needs before developing a learning tool for them. For example, one of the highlighted characteristics of the preservice teachers in this setting was limited experience with mathematics and different levels of mathematics preparation among them. The activities provided content discussions before the pedagogical discussions. Also, the activities were in an order to prepare participants to higher thinking levels and more complex parts of the topics.

Discussion

Therefore, as this study provides further understanding on teachers' geometry content knowledge for the particular setting, it also stresses the necessity to study teachers' mathematics content knowledge especially geometry knowledge. This study informs mathematics teacher education in three important areas. First, preservice teachers' reported their limited geometry knowledge as being parallel to previous studies (Jones, 2000; Swafford et al., 1997). Second, for teacher education, learning to teach geometry activities addressing the topics in the context of teaching should be favoured. Instead of knowing factual knowledge of mathematics, teachers should possess specialized content knowledge of mathematics for teaching (Ball et al., 2008). The last but not the least implication of this study is on using student work with teachers. Using student work in the context of preservice and in-service teacher settings might result in different outcomes. In the case of in-service teachers, participants apply the mathematics tasks with students and then analyze their work. On the other hand, in this study, preservice teachers analyzed the student work that collected by the researchers. They never experienced interacting with students about the given mathematics tasks. Even though, it cannot be said for sure about the effect of applying the tasks with students, it is worth to study more about it.

Acknowledgements

Endnote 1: Copyright © 2006 The Regents of the University of Michigan. For information, questions, or permission requests please contact Merrie Blunk, Learning Mathematics for Teaching, 734-615-7632. Not for reproduction or use without written consent of LMT. Measures development supported by NSF grants REC-9979873, REC- 0207649, EHR-0233456 & EHR 0335411, and by a subcontract to CPRE on Department of Education (DOE), Office of Educational Research and Improvement (OERI) award #R308A960003.

● ● ●

References

Aslan-Tutak, F. (2009). A Study of Geometry Content Knowledge of Elementary Preservice Teachers: The Case of Quadrilaterals (Doctoral dissertation), University of Florida, Gainesville, Florida.

Ball, D. L. (1988). Unlearning to teach mathematics. For the Learning of Mathematics, 8(1), 40-48.

Ball, D. L. (1990a). The mathematical understandings that prospective teachers bring to teacher education. The Elementary School Journal, 90(4), 449-466.

Ball, D. L. (1990b). Prospective elementary and secondary teachers' understanding of division. Journal for Research in Mathematics Education, 21(2), 132-144.

Ball, D. L. (2000). Bridging practices: Intertwining content and pedagogy in teaching and learning to teach. Journal of Teacher Education, 51(3), 241.

Ball, D.L., Thames, M.H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? Journal of Teacher Education, 59 (5), 389-407.

Barrantes, M., Blanco, L. J. (2006). A study of prospective primary teachers' conceptions of teaching and learning school geometry. Journal of Mathematics Teacher Education, 9, 411-436.

Brown, C. A., & Borko, H. (1992). Becoming a mathematics teacher. In D. A. Grouws (Ed.), Handbook of research on mathematics teaching and learning (pp. 209–239). New York: Macmillan.

Browing, C., Edson, A.J., Kimani, P., Aslan-Tutak, F. (2014) Mathematical Content Knowledge for Teaching Elementary Mathematics: A Focus on Geometry and Measurement. The Mathematics Enthusiast, 11(2), 333–384

Bruner, J. (1990). Acts of Meaning. Cambridge, MA: Harvard University Press.

Carpenter, T. P., Fennema,E., Peterson, P. L. & Carey, D. A. (1988). Teachers' Pedagogical Content Knowledge of Students' Problem Solving in Elementary Arithmetic. Journal for Research in Mathematics Education, 19(5), 385-401.

Carrillo, J., Climent, N, Contreras, L.C. & Muñoz-Catalán, M.C. (2013). Determining specialised knowledge for Mathematics teaching. Proceedings of Eighth Congress of European Research in Mathematics Education (CERME 8), Retrieved from http://cerme8.metu.edu.tr/wgpapers/WG17/Wg17_Climent.pdf

Carter, K. (1993). The place of story in the study of teaching and teacher education. Educational Researcher, 22(1), 5-12.

Chinnappan, M., Nason, R., Lawson, M. (1996). Perservice teachers' pedagogical and content knowledge about trigonometry and geometry: An initial investigation. In P.C. Clarkson (Ed.), Proceedings of the 19th Annual Conference of the Mathematics Education Research Group of Australasia. Melbourne MERGA.

Clandinin, D.J. and Connelly, F.M. (1996). Teachers' professional knowledge landscapes: Teacher stories – stories of teachers – school stories – stories of schools, Educational Researcher, 25(3), 24–30.

Coffey, A., & Atkinson, P. (1996). Making sense of qualitative data: Complementary

strategies. Thousand Oaks, CA: Sage.

Cortazzi, M. (1993). Narrative Analysis. London: Falmer.

Doyle W. & Carter K. (2003). Narrative and learning to teach: Implications for teacher education curriculum, Journal of Curriculum Studies, 35(2), 129-137.

Driscoll, M., Egan, M., Dimatteo, R. W. & Nikula, J. (2009). Fostering geometric thinking in the middle grades: Professional development for teachers in grades 5-10. In T. V. Craine & R. Rubenstein (Eds) Understanding geometry for a changing world: Seventy-first yearbook (pp. 155-171). Reston, VA: National Council of Teachers of Mathematics.

Elbaz, F. (1991), Research on teachers' knowledge: The evolution of a discourse, Journal of Curriculum Studies, 23(1), 1–19.

Franke, M.L., & Kazemi, E. (2001). Learning to teach mathematics: Developing a focus on students' mathematical thinking. Theory into Practice, 40, 102-109.

Grbich, C. (2007). Qualitative data analysis: An introduction. Thousand Oaks: SAGE.

Hatch, J., A. (2002). Doing qualitative research in education settings. Albany : State University of New York Press.

Hill, H. C., Schilling, S. G., & Ball, D. L. (2004). Developing measures of teachers' mathematics knowledge for teaching. The Elementary School Journal, 105(1), 11-30.

Hill, H.C., Sleep, L., Lewis, J. M., Ball, D. L. (2008). Assessing teachers' mathematical knowledge: What knowledge matters and what evidence counts? In F. K. Lester (Ed.), Second Handbook of Research on Mathematics Teaching and Learning (pp. 111-155). Charlotte, NC: Information Age Publishing.

Jacobson, C. & Lehrer, R. (2000). Teacher appropriation and student learning of geometry through design. Journal for Research in Mathematics Education, 31(1), 71-88.

Jones, K. (2000). Teacher Knowledge and professional development in geometry. Proceedings of the British Society for Research into Learning Mathematics, 20(3), 109-114.

Kazemi, E., & Franke, M.L. (2004). Teacher learning in mathematics: Using student work to promote collective inquiry. Journal of Mathematics Teacher Education, 7, 203-235.

Lampert, M. (1988). Teachers' Thinking about Students' Thinking about Geometry: The Effects of New Teaching Tools. Technical Report, Washington, DC: Office of Educational Research and Improvement.

Labov, W. (1972). Language in the inner city. Philadelphia: University of Pennsylvania Press.

Labov, W. (1982). Speech actions and reactions in personal narratives. In D. Tannen (Ed.), Analyzing discourse: Text and talk (pp. 219-247). Washington, DC: Georgetown University Press.

Lampert, M. & Ball, D. L. (1998). Teaching, multimedia, and mathematics. New York: Teachers College Press.

Leikin, R., Berman, A., Zaslavsky, O. (2000). Learning through teaching: The case of symmetry. Mathematics Education Research Journal, 12(1), 18-36.

Leinhardt, G., & Smith, D. A. (1985). Expertise in mathematics instruction: Subject matter knowledge. Journal of Educational Psychology, 77(3), 247-271.

Little, J. W. (2004). "Looking at student work" in the United States: Countervailing impulses in professional development. In C. Day & J. Sachs (Eds.), International handbook on the continuing professional development of teachers. Buckingham, UK: Open University.

Lloyd, G. M. (2005). Beliefs about the teacher's role in the mathematics classroom: One student teacher's explorations in fiction and in practice. Journal of Mathematics Teacher Education, 8(6), 441-467.

Lloyd, G. M. (2006). Preservice teachers' stories of mathematics classrooms: Explorations of practice through fictional accounts. Educational Studies in Mathematics, 63(1), 57-87.

McAdams, D.P. (1993). The stories we live by: Personal myths and making of the self. New York: Morrow. Ma, L. (1999). Knowing and teaching elementary mathematics: Teachers' understanding of fundamental mathematics in China and the United States: Lawrence Erlbaum Associates.

McGuire, P. (2013). Using online error analysis items to support preservice teachers' pedagogical content knowledge in mathematics. Contemporary Issues in Technology and Teacher Education, 13(3), 207-218.

National Council of Teachers of Mathematics. (2006). Learning from NAEP: Professional Development Materials for Teachers of Mathematics. Reston, VA: National Council of Teachers of Mathematics.

Owens, J. E. (1987). A study of four preservice secondary mathematics teachers' constructs of mathematics and mathematics teaching. Unpublished doctoral dissertation, University of Georgia, Athens, GA.

Post, T., Harel, G., Behr, M. & Lesh, R. (1988). Intermediate teachers' knowledge of rational number concepts. In E. Fennema, T. Carpenter & S. Lamon (Eds.), Integrating research on teaching and learning mathematics (pp. 194-219). Madison, WI: Wisconsin Center for Education Research, University of Wisconsin.

Riessman, C. K. (1993). Narrative analysis. Newburk Park, CA: Sage.

Riessman, C. (2000). Analysis of personal narratives. In J. Gubrium & J. Holstein (Eds.), Handbook of interviewing (pp. 1-27). Newbury Park, CA: Sage

Robichaux, C. M. (2002). The practice of expert critical care nurse in situations of prognostic conflict at the end of life. Unpublished dissertation: University of Texas at Austin.

Sarac, A. (2012). The relation of teacher efficacy to students' trigonometry self efficacy

and trigonometry achievement. Unpublished master thesis, Bogazici University, Turkey

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. Educational Researcher, 15(2), 4-14.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. Harvard Educational Review, 57(1), 1-22.

Smith, M.S. (2003). Practiced-based professional development for teachers of mathematics. Reston: NCTM.

Steinberg, R., Haymore, J., & Marks, R. (1985, April). Teachers' knowledge and content structuring in mathematics. Paper presented at the annual meeting of the American Educational Research Association, Chicago.

Swafford, J. O., Jones, G. A., Thornton, C. A. (1997). Increased knowledge in geometry and instructional practice. Journal for Research in Mathematics Education, 28(4), 467-483.

Tatto, M., Schwille, J., Senk, S., Ingvarson, L., Peck, R., & Rowley, G. (2008). Teacher education and development study in mathematics (TEDS-M): Policy, practice, and readiness to teach primary and secondary mathematics. Conceptual framework. Amsterdam: IEA.

Van de Walle, J. A. (2007). Elementary and middle school mathematics (6th ed.). Longman: New York.

International Electronic Journal of Elementary Education, 2015, 7(3), 319-332.

Pre-school Students' Informal Acquisitions Regarding the Concepts of Point and Straight Line

Keziban ORBAY *
Amasya University, Turkey

Mehmet Hikmet DEVELİ
Amasya University, Turkey

Received: 25 February 2015 / Revised: 5 April 2015 / Accepted: 18 May 2015

Abstract

This study aimed to investigate the informal cognitive structures regarding "point" and "straight line" -two basic and undefined terms of geometry- in children registered in preschool – the previous step before in-class formal education process. The study was conducted with the participation of 50 children enrolled in nursery, kindergarten and preschools of a total of five educational institutions -three public and two private- in a city which is in the middle of the Turkey. The qualitative research model was utilized in the study since observing, analyzing and assessing children's intuitive thinking and informal knowledge construction process would be difficult and good results would not be obtained via quantitative research methods. Data were collected through clinical interview technique. Results show that children, in general, possess major and to a large extent correct acquisitions that would be the basis of subsequent formal concept development process in children.

Keywords: Qualitative research, clinical interview, informal acquisition, point, straight line.

Introduction

In Mathematics teaching, it is known that children's intuitive learning especially in pre-school and first years of primary school provide an important foundation for future learning. Common opinion of many researchers (Ausubel, Gagne, Piaget and others) who generated the theoretical background related to this issue is: "when suitable learning environments are created, it is easier for the cognitive acquisitions (cognitive structures) obtained through children's intuitions to construct and transfer knowledge. Piaget argues that intuitive thinking starts at the beginning of year four (Ülgen, 1999). It is well known that modern mathematics teaching approaches are usually shaped based on this fundamental view.

** Keziban ORBAY, Amasya University, Faculty of Education, Department of Elementary Education, Amasya, Phone: (+90358)2526230, E-Mail: keziban.orbay@amasya.edu.tr

ISSN:1307-9298

Piaget stated that children construct knowledge themselves and this process called "adaptation" includes various sub-processes (assimilation, accommodation and equilibration) (Altun, 2010). In his studies related to concept formation, Piaget emphasized that analysis of the existing informal acquisitions should precede the formal formation process of a concept and stated that children's formal acquisitions are built upon these informal acquisitions (Altun, 2010; Günçe, 1973). Piaget also remarked that children construct knowledge on their own based on their own anatomical structures and through interactions with the environment and that especially language development and concept development go hand in hand (Ülgen, 2001).

Based on constructivist approach, current study aimed to observe the existing informal cognitive structures in children regarding the concepts of point and straight line -the two basic and undefined concepts of geometry- during the preschool period which is provided immediately before in-class formal education process and to discuss and interpret the contributions of this structure to formal education and training process.

According to Piaget and various clinical psychologists, it is rather hard and sometimes impossible to reconstruct misconceptions in children's cognitions (Ülgen, 2001). Children may not be able to ensure equilibrium between misconceptions and the correct constructs presented in the classroom and may face dual concept formation (one created by the children and one presented to the children), misconceptions and incomprehensibility in the future (Ülgen, 2001). Therefore, the current study hopes to observe possible misconceptions in children as well. It is necessary to point out here that this study does not intend to comprehend how cognitive constructs related to point and straight line concepts are generated in children. The study focuses on and is limited to observing and assessing the existing constructs.

Any scientific research –regardless of its field– is conducted with the help of a specific method or more than one method that complements one another. Various classifications are possible for different types of scientific research. One of these classifications distinguishes types of research as "descriptive", "relational" and "experimental" (Karakaya, 2011). Two major research methods in the field of mathematics teaching are "quantitative research" and "qualitative research" methods. Quantitative research is generally based on numerical data about mathematical knowledge and skills and is used to determine level/degree. On the other hand, the qualitative research method is used to observe the existing states in individuals and obtain and interpret general impressions that are not based on numerical data (Cemaloglu, 2011).

Qualitative Research Model

Current study is a descriptive qualitative research and information obtained from the related literature regarding the appearance, development, principles and techniques (alternative methods) of qualitative research method and suggested action research types are provided below in a partly chronological manner. The research is carried out in accordance with this model.

Paul Ernest defines qualitative research method as an important method whose developmental process is ongoing, uses the term "model" in the place of "method" and states that qualitative research method was first used in social research. He also points that qualitative research was first shaped in mathematics education research by Erlwanger (Ernest, 1998).

Ernest addresses the developmental process of qualitative research model as composed of three periods: "rationalist period", "modern period" and "post-modern period". He also argues that rationalist period started with Descartes and the modern period commenced with Piaget (Ernest, 1998).

Piaget started his qualitative research in 1920's (Ginsburg, 1981). Piaget employed a clinical interview technique in his research to comprehend small children's cognitive constructs of and how knowledge is constructed in the minds of children. For long years, Piaget used standard tests that utilized this technique but after the 1950's, he tried to integrate some flexibility in the technique (Ernest, 1998; Ginsburg, 1981).

Starting with 1970's, this model and post-modern research that highly contributes to the development of epistemology are more prominent. Erlwanger, Rorty, Gardes, Gardner, Zoslovsky, Ginsburg, Ernst von Glasersfeld, Erickson, Croswell, Goldin, Silverman and Kilpatrick can be cited among the prominent researchers in the post-modern era. Some of these studies focused on "psychology of learning" whereas others focused on "problem-solving" (Baki, Karataş & Güven, 2002; Ekiz, 2004; Ernest, 1998; Ginsburg, 1981).

Clinical Interview Technique

The clinical interview is regarded as the most suitable technique to observe and interpret existing acquisitions of small children and suggest future measures. However, it is stated that this technique is rather difficult and risky; it requires diligence in terms of reliability and validity and in order to increase validity and reliability, it is necessary to employ the technique by freeing it from obligatory standards and to administer it in a flexible manner in the form of semi-structured activities (Çepni, 2007; Ekiz, 2004; Ginsburg, 1981). Therefore, the sequence of experiences for the activities should be the same for each interviewer but questions and stimulants should be systematic and somewhat impromptu according to the atmosphere, children's desire for synergy and the developed empathy and dialogue. Success mostly comes from researcher's ability to empathize and his/her research experiences (Ekiz, 2004; Ernest, 1998).Activity instructions and observation forms should be prepared beforehand for clinical interviews and sequential experiences should be realized by "working together" with children and should be immediately recorded. According to the above information, this type of activity can be cited as "structured fieldwork" (Cemaloğlu, 2004).

The items below should be taken into consideration during the interviews in the light of the relevant literature:

- Doing interviews while seated at a table may not provide best results. Therefore, children's natural environments (floor, play corner, etc.) should be preferred. Children may present some cognitive skills in their natural environments while they may not be able to display them in artificial environments (such as interview rooms) (Ginsburg, 1981).
- Interviews should be carried out in accordance with the anatomical structure of the children and their current affective states (excitement, use of the left hand, style of using materials etc.) (Ernest, 1998; Goldin, 1998).
- It is possible for children to provide unexpected, surprising and interesting answers during interviews. In such cases, it is necessary to focus on the answer during the interview of in the upcoming interviews and impromptu questions should be carried in an order of increasing accuracy to comprehend the actual cognitive constructs (Bacanak, 2008).

- Children should be given ample time to give their answers and to present their answers by doing whereas no interventions should be provided other than small tips (if necessary).
- Children should feel free to ask questions when they do not understand the questions and when they need clarification or explanations.
- When the children are unwilling to work together, when they feel disinterested in any part of the interview or when they lose motivation, it is not wise to commence or continue the interview.
- When a question is unanswered, the interviewer can move on to next question provided that willingness and motivation still exist (Ginsburg, 1981).

Method

Based on the rationale presented in Introduction, it was decided to undertake the study in the form of one-on-one interviews with the children in an appropriate environment and to use written observation forms only with the concern that voice recording or video recording may distract 4-6 year-olds although voice or video recording is generally suggested (Bacanak, 2008; Clarke, 1998; Ekiz, 2004).

Creating the Hypothesis

Gestalt Theory which was started at the beginning of 1990's by Wertheimer, Kafka and Köhler; and was evolved after the years of 1990's especially in America and has still been evolving is a teaching and learning theory that was formed against Behaviorist's warning response theory. This theory is also against Constructivist Theory's in-depth analysis that reduces to elements of mind (Senemoglu, 2002; Yıldırım, 2008; Schunk, 2009). Gestalts advocate that introspection method of structuralists is a suitable method for examine learning case however, it is used wrong. They assert that it is better to handle mental experiences organized as a whole instead of analyzing segmentally (Senemoglu, 2002).

As discussed in the introductory part, the observation of a configured shape as intuitively is targeted, not the way of how the concept of points and lines is shaped in children. It is understood that it is configured the point as a small circular track and the line as a flat and solid line. In addition, this situation can be observed and analyzed at a satisfactory level with using proper materials.

It was supposed that "children between the ages of 4–6 may have informally perceived the point as a very small circular trace and the straight line as a straight and unbroken line". Based on this hypothesis, materials to work on point and straight line concepts and "instructions" and observation forms" for interviews were created.

Materials

For working on the concept of point: blank papers, papers presenting single colored very small points (zero-dimensional), as a distractor somewhat larger points (small filled circles), small scale circles, filled or empty triangles, alike squares and very short lines.

For working on the concept of straight line: blank and lined (squared) white papers, papers presenting black colored lines, curves, broken lines, disconnected lines etc., strings, rubbers and short bent plastic rods (3–4 cm).

Instructions

Sequential experiences designed for the concept of point:

- The child is provided with a blank paper and pencil and asked to form points on the paper. The child is asked to compare actual formations by drawing attention to possible wrong formations (Which one is better? Which one looks more like a point? Is it like the one you make with your finger? etc.)
- The paper that includes points and distractors are placed on the table and the child is asked to point to the points. Possible wrong selections and correct selections are compared and questions are directed about the differences between them (Does it look like the one you drew with the pencil? What is the difference? Can you try one more time? etc.)
- The researcher draws a simple shape on a blank paper (triangle, circle, square etc.) and the child is asked to create a similar one by using points.
- The child is congratulated at the end of the activity. The child is expected to answer questions such as "Yes, so what is a point?", "What does it look like?" and to point to the points.
- The researcher records his/her observations and the dialogs for each sequential experience in the observation form with care and diligence.

Sequential experiences designed for the concept of straight line:

- A similar discussion platform is created by mentioning the term "straight line".
- The child is provided with a blank paper and pencil and asked to form/draw several straight lines on the paper. The child is asked to compare actual formations by drawing attention to possible wrong formations (Do you think that part of the line is fine? Can you see the difference between them? How would you draw the best one if you did it again? Shall we do it again? etc.). Also, the reactions are recorded.
- The child is provided with a lined (squared) blank paper and asked to draw several straight lines. Whether the child takes the lines on the paper as a reference is noted and recorded.
- A white colored paper with straight lines, curves, broken and disconnected lines is presented to the child and he7she is asked to select the correct ones among the lines. A dialog similar to the one experienced for the concept of points is generated for possible wrong selections. If all selections of the child are correct, he/she is asked to make comparison with a sample that is wrong (For instance, why did not you choose this one? What would you say if I selected this one? etc.). Based on the answers, question-answer session continues.
- The child is provided with a piece of string and asked to form a line using the string. He/she is asked to do the same with the rubber. Whether the child uses both hands and whether the materials are stretched is observed for both materials. If the child is not stretching the materials sufficiently, he/she is asked to do so and asked questions about the difference between both cases. The researcher may intervene when the string is stretched and asks the difference between the two conditions (What happened now? What should we have done? What should I do? What happens if I do this? etc.). Then the researcher presents 6-7 rods with some curved parts and asks the student to use three rods to make a straight line by placing them side by

side. Questions are asked about possible wrong selections (Is this rod OK? Is it fine now? What should we do? etc.)

- Finally, last ideas are collected with questions such as "Yes, so what is a straight line?" and "How do we make a straight line?" If necessary, actions are used to present the ideas.
- Observations and impressions during the sequential experiences are recorded in the observation form in the same way it is handled for the point concept.

Testing the Hypothesis

Based on a consensus with their teachers, 10 children (one female and one male student from each school) between 50-70 month chronological age were selected from the nursery, kindergarten and pre-school classes of the five schools. The schools were contacted beforehand to obtain necessary permits for the study.

Two researchers visited the identified schools. The study was conducted with the selected students in a separate location (in a separate corner of the class) away from the rest of the classroom and necessary notes were taken. Based on the impressions obtained during the hypothesis testing phase, required changes in the instructions for the general implementation, the manner of getting together with the children at the beginning of the study and the necessary actions to determine effective readiness (suppress excitement, increase curiosity, generate willingness etc.) were identified.

Since satisfying levels of empathy were established with the children during test hypothesis phase, researchers felt that the test was successful and experienced self-esteem for the actual implementation. It was also believed that experienced gained in a similar qualitative research (Develi & Orbay, 2002) would support the implementation.

Establishing the actual working group

20 children who completed year 4 and 20 children who completed year 5 were selected based on teacher views from the identified schools by taking their chronological age into consideration and ensuring balanced gender distribution. In each school, all the children with prior nursery school experience were included in the working group. Instructions for the activities were reorganized in line with the observations obtained during the hypothesis testing phase. Materials were improved and finalized for the implementation.

Results

The implementation was carried out in 10 working days in the identified schools. Two researchers worked in separate environments by dividing the number of children among themselves. Insufficient motivation, problems in the flow of sequential experiences due to various reasons, negative reactions (sudden silences, shrugging etc.) and unwillingness were observed just a few times (in 4 children). Interviews were stopped with these children and other children were included in their places. Almost all the children started the interviews with high motivation at first maybe due to the promised reward. All children behaviors during interviews, their surprising comments, interesting dialogs that took place and their drawings were collected diligently for assessment. 36 of the 40 children that participated in the implementation provided fun and challenging, surprising and interesting dialogs and displayed amazing actions. In order to clarify the data analysis, some of these dialogs were given as examples below and the first example was detailed.

Example 1

Researcher: K.O.

Child friend: Z. B. G.

K.O.: Welcome, my friend (they shake hands). My name is K.O. Can I learn your name?

Z.B.G.: Z.B.G.

K.O.: Z.B., now we are going to undertake a very entertaining activity with you. I believe we will be successful. You know there is a reward at the end!

Z.B.G.: OK!

K.O.: Z.B., can you tell me what a point is?

Z.B.G.: Circle

K.O.: OK, can you also tell me how a point looks like? For instance, if I ask you to show me with your finger!

Z.B.G.: The child taps the low table with the tip of is/her index finger: Tap! Tap!

K.O.: Well done! Congratulations! Now can you make a few points on this paper with this pencil?

Z.B.G.: The child is carefully making points by using the tip of the pencil (Figure 1).

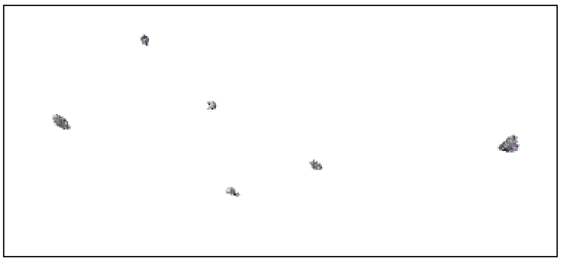


Figure 1. Marking points

K.O.: Nice job! Congratulations! Now I will give you a paper. There are some marks on it. Can you show me which of these marks are points? It is sufficient to point with your finger!

Z.B.G.: OK! (The child points to all objects shaped like the following ". , ., o".)

K.O.: "If I told you to select only one of them", which one would you choose as the point?

Z.B.G.: The child selects the ".".

K.O.: Why did not you select "o"?

Z.B.G.: Because it is blank inside.

K.O.: Then why did not you select "."?

Z.B.G.: It is very big!

K.O.: We are getting closer to the end of the point work, Z.B.! Now I will draw a figure for you. Can you do the same for me with points, I mean by using points?

Z.B.G.: I can!

K.O.: Here is a figure for you. Do it and we will see!

Z.B.G.: Hmm, this is a triangle! It is easy! (The child finishes Figure 2 in a short time)

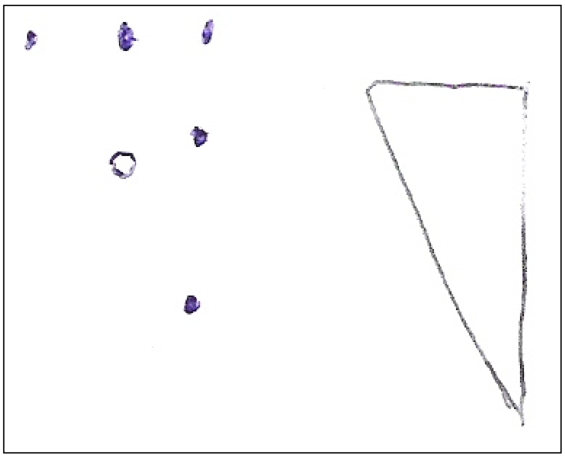


Figure 2. Drawing triangles by using points

K.O.: Great work! So, what is the point? How is it then?

Z.B.G.: Just like that! (The child shows the shapes on the paper other than "o" and touches them with the tip of her finger)

K.O.: Applauds from me! Congratulations! You are very successful! Now let's rest for a while. We will undertake another small activity shortly. It won't take a lot of your time! Your reward is waiting for you! (They rest)

K.O.: Now let's move on to the straight line! Are you ready?

Z.B.G.: Yes.

K.O.: Z.B., what is a straight line?

Z.B.G.: The child does not answer. He/she shrugs.

K.O.: OK. Z.B., what is a line then? How is it made?

Z.B.G.: Hmm, that! The child draws a line on the floor that looks close to a straight line.

K.O.: Dear Z.B., how is a very straight line then?

Z.B.G.: The child draws a line with her finger more carefully.

K.O.: Dear Z.B., the last line you drew, the one that is "very straight", is called a "straight line".

Z.B.G.: You mean a road!

K.O.: Very true! Bravo! Now, draw a few straight line son this paper with the pencil!

Z.B.G.: Ooo it is very easy! (The child draws the vertical line provided below, Figure 3).

K.O.: Now let's make another one like this (the researcher roughly points to the horizontal line).

Z.B.G.: The child draws the line on the paper (provided above) (he/she does not use the lines on the lined paper as a reference, Figure 4).

K.O.: Bravo! Bravo! Now I will show you another paper that looks like the previous one. I will ask you to select the "straight lines" from the figures.

Please pay attention dear Z.B.! (The child mostly pointed to the straight lines however he/she also marked  those)

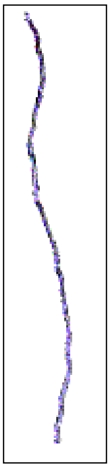


Figure 3. Vertical line

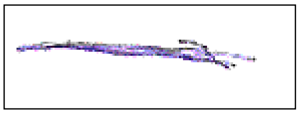


Figure 4. Horizontal line

K.O.: Ok, so which ones are correct? These or  (The child does not answer, purses lips!)

K.O.: Dear Z.B., are there any differences between these two? Pay attention!

Z.B.G.:  has a hole!

K.O.: Then?

Z.B.G.: The child hesitantly points to

K.O.: Why?

Z.B.G.: Because, there shouldn't be any holes.

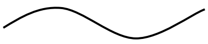
K.O.: Hımm! Bravo! Z.B., now I will give you a piece of string. Can you make a straight line for me using this?

Z.B.G.: I can! It is easy! (The child holds the stretched string parallel to the floor with her hands.)

K.O.: Nice! Can you also do the same with the rubber?

Z.B.G.: Yes, it is easy! (The child stretches the rubber.)

K.O.: We are almost done! One last experiment! (The researcher takes out 6-7 plastic rods some of which are curved). Come on! I want you to select 3 of these and connect them like this (displays with both fingers) to make a straight line. You have only three options! Pay attention, good luck.

Z.B.G.:  (the child makes the selections)

K.O.: Don't you think there is something wrong here? What do you say?

Z.B.G.: Ha, yeees, the one in the middle does not fit!

K.O.: OK. Now, select something else instead of it.

Z.B.G.: The child makes the correct selections and places them where they belong.

K.O.: Good job! So, what is a straight line then?

Z.B.G.: It is a very straight line, like this (Shows with hands)!

K.O.: You are a very successful child. Thanks for working with me! Would you like a chocolate Miss Z.B.? (They share laughter, researcher pats her head and they say goodbye)

Example 2

Researcher: H.D.

Child friend: D.M.

H.D.: Can you make a shape that is similar to the one I will draw by using points?

D.M.: Yes! Like that. (Figure5)

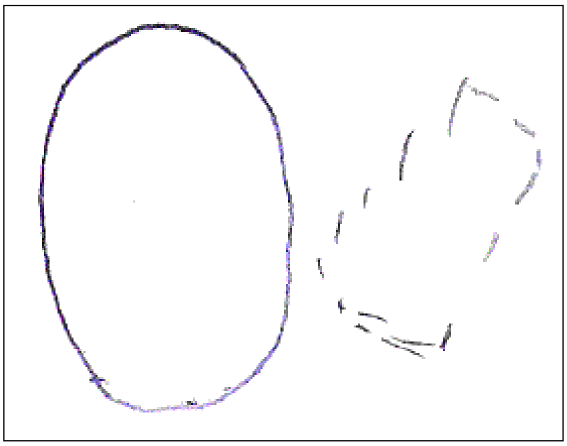
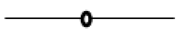


Figure 5. Shape

H.D.: Why did not you select this? (Pointing to )

D.M.: Because it is wavy.

Example 3

K.O.: Why did you select this? (Pointing to )

Z.İ.: Because they are the most beautiful ones!

K.O.: Why?

Z.İ.: Looks like a necklace!

Example 4

H.D.: Why did not you select this? (Pointing to )

Y.Ö.: Zigzags won't do!

Example 5

H.D.: What is a straight line?

K.D.: It means it is not wrong! (Confuses the terms since Turkish word for straight line also means true/correct)

H.D.: I did not mean that. How do we draw a straight line?

K.D.: Ooo, you mean this? Just like that (draws with finger).

Example 6

H.D.: The researcher holds the pencil to the stretched string and forms a bulge and asks, "So, it is Ok now?"

Ç.Ö.: Nooo!

H.D.: Why not?

Ç.Ö.: Because it cannot have a peak!

Data Analysis

As the interviews of the study were conducted as open-ended questions, analyze of the data was executed responsively to the extent allowed by the literature (Cemaloğlu; 2011; Çepni, 2007).

As was expected, it was observed that it required expertise to continue the implementation, from appropriate dialogues, suitably generate the question chain, comprehend what the children mean and make sense of children's gestures and facial expressions. It was observed that children left some questions unanswered although in our opinion they looked easy to understand and answer or they provided insufficient or incorrect answers to them whereas they were able to answer questions that required higher level competence with unexpected level of correctness and meaning. For instance, it was observed that the child who drew the straight line as the curve was able to select the correct options from among the distracters and another child who selected the curve instead of the straight line was able to identify the fact that the string would be taut while making a line and implement the action as well.

Although the first step in concept development process is "informal recognition", the sequential experiences activities we designed purposefully aimed to collect children's views about point and the straight line, which can be regarded as the informal definition step. This was designed for two purposes. Firstly, it was aimed to observe the consistency between children's ideas and impressions about the concepts of point and straight line and the mechanical formation and use of those concepts during the activities in implementation and secondly, it was aimed to compare and interpret answers to "so what is a point?" and "so, what is a straight line?" provided by the children at the end of activity and their behaviors during the process. As a result of the activities designed with those purposes, it was observed that the majority of children- other than a few exceptions- was able to define the concepts correctly by pointing to the concepts instead of talking about them and they were also able to relate correct views when they were asked although their ideas did not fully cover the topic.

Children, in general, perceive the point as a very small circle object. However, sometimes they can select or perceive formations that are larger or full in the inside as points as well. This may be related to their idea of making the point more observable rather than lack of perception or misconceptions. It was observed that children did not identify geometric figures that are full in the inside, that are very small or empty in the inside or that have corners as points. Also when children with previous nursery school experiences and children who have learned the figures of triangles, rectangles, squares and circles in preschool classes until the implementation date were asked why they did not select these figures as points, their answers included statements such as "because it is a triangle…etc" which showed that perception of the concept of point as an object with no dimension (with zero dimensions). Children were able to display expected behaviors when they were asked to form simple shapes using points with appropriate tips (form the shape by using points). This competence shaped the opinion that the children were ready to use points as basic geometrical instruments. Although there were no significant differences between children who completed year 4 and 5 in terms of recognition and use of points, it was observed that children who completed year 5 needed fewer tips and researcher support. It was seen that the majority of children were not able to answer the question "in your opinion, what is a straight line?". Probably due to the fact that this concept was not introduced as a geometrical thought during class activities at the time of the implementation. But they were able to provide expected answers to the question "what is a line?" even though they mostly pointed to lines while replying. It was identified in the interviews held with the teachers of the children that the children that participated in the implementation were able to recognize and use concepts such as "line" and "rod" during class. This information led us believe that the children actually perceive the straight line as continuous, unbroken and unbent straight line and that their hesitations at the beginning of the activity resulted from lack of familiarity with the words used to describe the concept, not with the concept itself. The majority of children were observed to be able to select the correct option from among the distractors. However, a small minority of children selected the shapes that looked nice to them. When those children were asked to compare their selections with the actual answer, they did not select the shapes that they pointed at first. When they were asked why they changed their minds, they started with their own words that they later realized the discontinuous nature of the shape ("it is broken", "there can't be hopes in it" etc.). these statements led the researchers believe that misperceptions were somewhat psychological and sometimes they resulted from carelessness. The children were successful when they were given enough tips (such as use both hands, connect by bringing both ends together etc.) during formation of the straight line with materials (string, rubber, rods). They generally drew the straight line as vertical and this may be related to the implementation of drawing number 1 as a vertical line during preschool classes while learning number 1. Children used the line of lined paper during this action. However, when horizontal lines were pointed and they were asked to "draw another one like that", they were somewhat less skillful and did not use the lines of the paper as reference. This finding points the fact that the concept of lines is perceived intuitively, but intuitive competence was not developed at the point. Broken, curved or disconnected lines were not credited with the following reasons: "this has zigzags, this won't do", "it is like the sea", "it is wavy", "it spreads out from the borders", "it is disconnected, it has holes", "it is curvy", "it is like a mountain (hill)", "it goes to the side", "it is skewed". These statements show that the majority of the children had a cognitive competence to identify the correct shape from among the distractors.

Results and Recommendations

Study results generated the view that children between the ages of 50-70 months had important and mostly correct informal acquisitions about the concepts of point and straight lines. These informal acquisitions will be the basis of future formal concept development. We believe that similar studies that will be held in similar environments will result in similar findings as well.

Significant findings were not reached during the study about how the children acquired these perceptions. It is known that, regardless of the concept, it is the hardest part of studies to comprehend and interpret informal acquisitions of children (Ernest, 1998). Therefore, as mentioned in the introduction, the study did not intend to focus on this area.

We believe that the study provides a good example to preschool teachers who undertake semi-formal training activities and especially to first grade teachers about the importance of children's informal acquisitions and the need to establish formal training on this basis. Especially while starting to teach similar concepts; it is suggested for preschool and classroom teachers to carefully use the question-answer technique similar to the one used in the study and to frequently engage in dialogues with students about children's informal acquisitions and to direct their teaching based on the impressions gained from these interviews and dialogues. It is imperative to achieve high quality in preschool education which is becoming widespread in our country.

Assessment of the semi-informal acquisition process efficiently will be the precondition of minimizing possible future misconceptions, ambiguities and formation of double concepts.

Acknowledgements

We would like to thank the preschool teachers who provided the researchers with information about the students and made important contributions to the study with their views during the study.

● ● ●

References

Altun, M. (2010). Eğitim Fakülteleri ve Sınıf Öğretmenleri için Matematik Öğretimi, Aktüel Alfa Yayınevi, Bursa.

Bacanak, A. (2008). Fen ve Teknoloji Dersi Performans Değerlendirme Formlarına Yönelik Oluşturulan Web Tabanlı Programın Etkinliğinin Araştırılması, Yayımlanmamış Doktora Tezi, Trabzon.

Baki, A., Karataş, İ., Güven, B. (2002). Klinik Mülakat ile Problem Çözme Becerilerinin Değerlendirilmesi, V. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi, 1043–1049, Ankara.

Cemaloğlu, N. (2011). Veri Toplama Teknikleri Nicel-Nitel, Bilimsel Araştırma Yöntemleri, 131–164, Ed. A. Tanrıöğen, Anı Yayınları, Ankara.

Çepni S. (2007). Araştırma ve Proje Çalışmalarına Giriş, Üçyol Kültür Merkezi Yayınları, Trabzon.

Clarke, D.J. (1998). Studying the Classroom Negotiation of Meaning: Complementary Accounts Methodology, Monograph, National Council of Teachers of Mathematics, 9, 98–111, USA.

Develi, M.H., Orbay, K. (2002). İşlem Öncesi Dönem Çocuklarında Sayı Kavramının Gelişimi Üzerine, V. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi, 969–974, Ankara.

Ekiz, D. (2004). Eğitim Dünyasının Nitel Araştırma Paradigmasıyla İncelenmesi: Doğal ya da Yapay, www.tebd.edu.tr/arsiv/2004-Cilt2/Sayı-4/415-439pdf., Ankara.

Ernest, P. (1998). The Epistemological Basis of Qualitative Research in Mathematics Education: A postmodern Perspective, Qualitative Research Methods Mathematics education, Monograph, National Council of Teachers of Mathematics 9 22–39, USA.

Ginsburg, H.P. (1981). The Clinical İnterview in Psychological Research on Mathematical Thinking: Aims, Rationales, Techniques, For the Learning of Mathematics, 3, 4–11.

Goldin, G. A. (1998). Observing Mathematical Problem Solving Through Task-Based İnterviews, Qualitative Research Methods Education, Monograph, National Council of Teachers of Mathematics, 9, 40–62, USA.

Günçe, G. (1973). Çocuk Zihin Gelişimi Piaget Kuramına Toplu Bakış, Baylan Matbaası, Ankara.

Karakaya, İ. (2011). Bilimsel Araştırma Yöntemleri, Bilimsel Araştırma Yöntemleri, 55–84, ed.A. Tanrıöğen, Anı Yayınları, Ankara.

Schunk, D., H. (2009). Öğrenme Teorileri Eğitimsel Bir Bakış, Nobel Yayın Dağıtım, Ankara

Senemoğlu, N. (2002). Gelişim Öğrenme ve Öğretim Kuramından Uygulamaya, Gazi Kitapevi, Ankara.

Ülgen, G. (1999). (C.M. Charles'den çeviri). Öğretmenler İçin Piaget İlkeleri, Anı Yayınları, Ankara.

Ülgen, G. (2001). Kavram Geliştirme Kuramlar ve Uygulamalar (3. Baskı), Pegem Yayınları, Ankara.

International Electronic Journal of Elementary Education, 2015, 7(3), 333-354.

Prospective Elementary School Teachers' Views about Socioscientific Issues: A Concurrent Parallel Design Study

Muhammet ÖZDEN*
Dumlupınar University, Turkey

Received: 9 February 2015 / Revised: 1 April 2015 / Accepted: 11 May 2015

Abstract

The purpose of this research is to examine the prospective elementary school teachers' perceptions on socioscientific issues. The research was conducted on prospective elementary school teachers studying at a university located in western Turkey. The researcher first taught the subjects of global warming and nuclear power plants from a perspective of socioscientific issues in the science and technology education course and then conducted the research. Concurrent parallel design, one of the mixed-method research approaches, was used to conduct the research. In this context, semi-structured interviews were conducted with eight teachers in the qualitative strand of the study to explore the phenomenon. The data obtained from the interviews were analyzed using thematic analysis. During the quantitative strand of the research, 113 prospective teachers were administered a questionnaire form. The results of the study revealed that none of the participating prospective teachers mentioned about the religious and cultural characteristics of socioscientific issues, and they need training about how to use socioscientific issues in teaching.

Keywords: Science Education, Scientific Literacy, Socioscientific Issues, Mixed Methods, Concurrent Parallel Design

Introduction

The main goal of science education is to enhance scientific literacy (American Association for the Advancement of Science [AAAS], 2009; Ministry of National Education [MoNE], 2013; National Research Council [NRC], 1996) and scholars argued that scientific literacy can be achieved by integrating socioscientific issues (SSI) into science education (Ekborg, Ottander, Silfver, & Simon, 2013; Kolstø, 2001; Sadler & Zeidler, 2005a, 2005b; Zeidler & Nichols, 2009).

SSI are contemporary controversial issues with no established consensus on, which arise from advances in science and technology and have individual, social, political, economic, ethical and moral aspects (Ozden, 2011). These issues can alternatively be defined as the issues which are complex, open-ended, have no definite solutions and

* ✉ Muhammet Özden, Dumlupinar University, Faculty of Education, Department of Elementary Education, Kutahya, Turkey Phone: +90 (274) 422-4612 E-mail: muhammetozden@gmail.com

ISSN:1307-9298

emerge in the form of controversial dilemmas (Sadler, 2004), that people face in their daily lives (Kolstø, 2001), that focus on scientific content and the social dimension of the scientific content (Topcu, 2010). The definitions suggest that in an educational approach based on SSI, students are faced with issues incompatible with their own belief systems or containing different scientific, social, and moral perspectives (Zeidler, Sadler, Applebaum, & Callahan, 2009).

SSI are generally related with advances in biotechnology and environmental problems (Sadler & Zeidler, 2005a). For example, deforestation, genetically modified foods (Foong & Daniel, 2013), climate change (Morris, 2014), cloning, nuclear energy, depletion of the ozone layer, and epidemics can be specified as SSI (Pedretti, 2003). In addition, some controversial issues such as embryo selection, stem cell, tissue or organ transplantation between two distinct species are acknowledged as SSI (Levinson, 2006). These issues are employed by science educators as current and interesting contexts, as well as being considered as significant social problems (Topcu, Yilmaz-Tuzun, & Sadler, 2011). It can be asserted that with the introduction of 3rd-8th Science Teaching Curriculum (MoNE, 2013) in 2013, Turkey had an opportunity for employing SSI in teaching.

There are certain reasons for employing SSI in science education. First of all, SSI are a means of improving scientific literacy (Sadler, 2009). SSI involve political, personal, and moral issues, as well as scientific claims and arguments. However, for many SSI, basic scientific claims are controversial. Therefore, when making decisions about these issues individuals should consider two main aspects, one being political/ethical and the other scientific (Kolstø et al., 2006). For example, it may be political decision when it comes to permitting to trade genetically modified food. On the other hand, whether genetically modified foods are a threat to human health is a scientific question, which receive different scientific explanations. Allowing the students to evaluate and construct their thought on the scientific descriptions, views, and arguments brought about the issues can be an example to the development and utilization of scientific literacy skills.

Secondly, SSI help students understand the social, moral, political and economic effects of science (Dawson, 2001) by providing a context for a better understanding of both the epistemological beliefs and science (Zeidler, Herman, Ruzek, Linder, & Lin, 2013). Thus, it becomes easier for the students to understand the nature of science (Jones et al., 2011). Students will realize that they use personal beliefs and values as well as scientific knowledge, while they are interpreting and evaluating evidence related to SSI, and offering solutions to these problems. In a curriculum based on SSI, for the students to use scientific knowledge together with their personal beliefs may help them realize the procedures and processes of science. Thus, it becomes easier to teach the nature of science within the context of SSI.

Thirdly, SSI help enhancing the students' abilities to make decisions based on evidence, to make argumentation, and to debate (Ideland, Malmberg, & Winberg, 2011), thus improving their analytical thinking skills. Since SSI are complex, open-ended, controversial problems with no definite answers, the possible solutions to the emerging dilemmas can be discovered if only multiple perspectives are employed. On the other hand, when limited and controversial sources of information are taken into consideration, students and ordinary citizens can develop their own cognitive constructs and produce explanations in response to the controversial scientific problems if they can develop informal reasoning skills (Sadler, 2004).

Finally, SSI make contributions not only to students' cognitive development but also to their emotional and social development (Topcu, 2010; Topcu, Sadler, & Yilmaz-Tuzun, 2010). Science teaching based on SSI supports the character development (Zeidler et al.,

2009) and citizenship skills (Barrue & Albe, 2013; Lee et al., 2013) of individuals by focusing on the discourse and regarding the moral and ethical issues. Thus it is apparent that use of SSI in science education has four main goals: to improve scientific literacy, to provide an understanding about nature of science, to enhance higher order thinking skills by promoting cognitive development, and finally, to ensure emotional and social development. The potential of SSI to perform multiple goals simultaneously, to offer students interesting and authentic learning experiences has led an increasing interest among science educators into this subject and facilitated its inclusion in the curriculum.

The movement of SSI has emerged in the United States (Saunders & Rennie, 2013). However there have been an increasing interest at the international level and many research carried out. Among these researches, the effect of SSI on scientific literacy (Kolstø et al., 2006; Ritchie, Thomas, & Tones, 2011) and learning the nature of science (Albe, 2008, Eastwood et al., 2012; Khishfe 2012, 2014; Sadler, Chambers, & Zeidler, 2004) have become the two important research topics. Another important field of researches included the attempts to understand the relationship between SSI and cognitive skills. In this context, some commonly studied topics included argumentation in SSI (Dawson & Venville, 2013), the transfer of argumentation skills (Foong & Daniel, 2013), decision making (Greschner, Hasselhorn, & Bögeholz 2013; Zeidler et al., 2009), epistemological (Zeidler et al, 2013), moral (Sadler & Zeidler, 2004) and informal reasoning patterns (Topcu et. al, 2010; Topcu et al., 2011). Similarly, the importance of content knowledge in terms of informal reasoning and argumentation skills has been studied (Sadler & Donnelly, 2006; Sadler & Zeidler, 2005b). Fewer studies investigated the relationship between SSI and learning outcomes as another component of the cognitive skills. In this respect, researches have focused on the effect of SSI in facilitating learning (Rudsberg, Öhman, & Östman, 2013) and on the learning outcomes (Ottander & Ekborg, 2012).

Previous research investigated SSI relationship with affective variables, in addition to the cognitive ones. In this respect, researchers have investigated the impact of the SSI students interest in and attitudes towards science lessons (Albe, 2008; Ottander & Ekborg, 2012; Thomas, Ritchie, & Tones, 2011) and prospective teachers' perceived competencies on SSI (Kara, 2012; Kilinc et al. 2013; Lee, Abd-El Khalick, & Choi, 2006). In a research study, an attitude scale towards SSI was developed (Topcu, 2010). Other research studies focused on difficulties teachers faced in classroom discussions (Day & Bryce, 2011), teachers' views on SSI (Ekborg et al., 2013), the role of SSI in citizenship education (Barrue & Albe, 2013; Lee et al., 2013), how SSI are used in classes with students representing different socioeconomic status and ethnicities (Ideland et al., 2011). One study evaluated how SSI are handled in textbooks (Morris, 2014).

Researches in the literature can be grouped under two categories according to the use of SSI: using socioeconomic issues as the goal and using socioeconomic issues as an instrument (Topcu, Mugaloglu, & Guven, 2014). In a more detailed analysis, the focus of the studies on SSI can be categorized as (i) the nature of science and scientific literacy, (ii) argumentation, reasoning and decision-making processes, (iii) content knowledge, (iv) views and sense of efficacy in using SSI in teaching, (vi) interest in and attitudes towards in science lessons. In this contexts, data were obtained from teachers (Day & Bryce, 2011; Lee et al., 2006), prospective teachers (Kara, 2012; Topcu et al., 2010), secondary (Ideland et al., 2011; Khishfe, 2014) and high school (Eastwood et al., 2012; Thomas et al., 2011) students. However, there is no study which focuses mainly on elementary school teachers regarding the SSI. Nevertheless, Alacam-Aksit (2011) conducted a research to detect the prospective elementary school teachers' on teaching of SSI.

Many research studies about SSI have not been directly associated elementary school teachers or prospective elementary school teachers. This implies that while the rapidly growing literature on SSI puts forward new implications for science education, the roles and functions of elementary school teachers have not been discovered yet. Because of the reasons specified above, new researches should be conducted to determine and improve the views prospective elementary teachers who will be responsible for guiding the science lessons in the future. Determining the views of prospective elementary school teachers may help evaluating the problems and views to affect their instructional practices. Moreover, such an evaluation may contribute to take necessary measures in the relevant field and to promote the quality of teaching activities to be planned for the students of prospective elementary teachers in the future. Therefore, determining the prospective elementary school teachers' views on SSI, their perceptions about the characteristics of SSI, and their beliefs about their roles as teachers will form the basis for an effective science teaching. In this respect, the aim of the present research is to examine the perceptions prospective elementary school teachers on SSI. This research study seeks answers to the following questions:

- What are the perceptions of prospective elementary school teachers about SSI?
- What are the views of prospective elementary school teachers about the use of SSI in science teaching at elementary school?
- Do prospective elementary school teachers' views on the use of SSI in science education differ significantly by gender to academic success?

Method

Design

Present study was conducted based on mixed methods design (Tashakkori & Teddlie, 2010). Mixed methods research merges qualitative and quantitative data to answer the research question (Creswell, 2014). There are other terms used to refer to mixed methods such as integration, synthesis, qualitative and quantitative methods, multiple methods, and mixed methodology (Byrman, 2006; Tashakkori & Teddlie, 2010). In the present study, mixed methods was used to overcome the restrictions of using either of the qualitative or quantitative approaches alone, and to find a comprehensive answer to the research question.

More specifically, the convergent parallel design, one of the mixed methods (Creswell & Plano Clark, 2011) was used in the study. In this design, qualitative and quantitative data were collected in a parallel manner, but analyzed independently. Next, qualitative and quantitative results were mixed to make an overall interpretation about the research question (Creswell & Plano Clark, 2011; Creswell, 2014).

There are some reasons for using the convergent parallel design. First reason is the need for different but complementary data regarding the research question, which is believed to lead to obtain a more effective answer to the research question. Second reason is to overcome the limitations to emerge when qualitative and quantitative would be used alone. Third reason is that this method allows comparing the qualitative and quantitative data in order to increase the internal validity of the study. In this respect, thanks to the qualitative data participants were able to comment on and explain the research topic in a detailed manner with their own words, and quantitative data made it possible to understand the perceptions of a larger group on SSI in general.

In the present study, both qualitative and quantitative methods were given the equal priority (Creswell & Plano Clark, 2011). That is, qualitative and quantitative procedures of the study had equal responsibility in answering the research questions. The symbolic representation of the design is QUAL+QUAN (Morse, 1991), which is displayed in Figure 1:

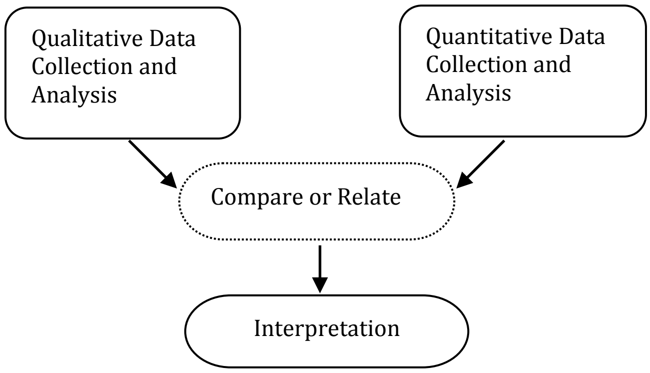


Figure 1. *Symbolic representation of research design* (Creswell, 2015).

Qualitative Strand

Context and Participants

Present research was conducted with the participation of prospective elementary school teachers studying at a State University in western Turkey. The researcher has taught Science and Technology Teaching course in the program mentioned above. SSI and their use in education was one of the topics involved in the course content. A two-week period was allocated for SSI in the Science and Technology Teaching course program. The researcher as the instructor discussed the topic of global warming during the first week and nuclear energy during the second week with the students. These rather current and interesting topics were selected because recently they have been discussed in the society broadly with their political, economic, ecological and scientific aspects. Participants were asked to find scientific articles offering different arguments about both topics, to read this article critically, and to use these articles while forming and defending their own ideas. Students participated into discussions directed by researcher after making these preparation before coming to the class. At the end of the second week of the discussions, researcher informed the participants that the topics discussed are named SSI in the relevant literature. Next, the participants were asked to reflect on the characteristics of SSI, the SSI that can be handled at elementary school level, the roles that teachers and students should have while addressing SSI based on the classroom discussions and to form their own opinions. At every stage of the research, the researcher refrained from disclosing his own ideas or giving information about SSI, but directed the participants to express their opinions based on political, social, economic, and moral aspects.

During the week after the classroom discussions were completed, the researcher announced the participants that he would like to conduct semi-structured interviews with to examine the educational characteristics of SSI, and he asked the volunteering participants to give feedback about their intent to take part in the study by sending an e-mail, visiting the researcher's office, or just calling. Since the research was conducted with the natural members of the researcher's class, convenience sampling method was used in the research (Yildirim & Simsek, 2013). After the announcement, 8 of the prospective teachers informed the researcher about their voluntary participation to the research either by visiting the researcher's office or sending a message via social network (Facebook) although it was not an announced way of feedback. Next, a timetable was arranged with the participants according to their convenient days and times, and semi-structured interviews were conducted according to this meeting schedule. Among the participants, five were women and three were men. In terms of their academic, while the 7 participants had average grade points of 3.00 or more, only one had an average grade below 2.99.

Data collection and analysis

The qualitative data of the study was collected through interviews (Spradley, 1979). Interviews are effective data collection tools enabling to obtain and record the individuals' or groups' views, feelings, ideas, values, attitudes and beliefs about their experiences and social worlds in in their own words (Saldaña, 2011). It is known that there are different approaches about classifying the interviews (Patton, 2001; ten Have, 2004; Spradley, 1979; Yildirim & Simsek, 2013). In the present study semi-structured interviews were used (Yildirim & Simsek, 2013). Open-ended questions are used in semi-structured. The main responsibility of the interviewer is to explore the participants' responses to open-ended questions and to build the research on the basis of their responses (Seidman, 2006).

The semi-structured interview form consisted of four open-ended questions. These questions are: 1) How do you describe in your own words the concept of SSI? 2) Can you give examples of SSI that can be used in science and technology courses? 3) What can be the contribution of involving SSI into science and technology course? 4) What should be the roles of teachers in teaching SSI? Interview questions were derived from notes the researcher took during class discussions and the relevant literature. All semi-structured interviews were conducted face to face with each participant individually.

Data were analyzed using thematic analysis (Gibson & Brown, 2009; Yildirim & Simsek, 2013). Thematic analysis requires the analysis of the data according to common features, relationships, and differences in the dataset (Gibson & Brown, 2009). Thematic analysis is a descriptive strategy which facilitates the search of patterns of experiences present in the qualitative dataset. Therefore, the outcome of the thematic analysis is a structure which enables the identification and integration of existing patterns (Ayres, 2008). In the thematic analysis, themes do not involve a process of simply counting the words (Firmin, 2008), but that of examining the structures both hidden and apparent in the data (Vaismoradi, Turunen, & Bondas, 2013).

The following sequential steps were followed during the thematic analysis: 1) identification of the data by the researcher, 2) the creation of basic codes, 3) establishment of leading themes, 4) revising themes 5) identifying and naming themes, and 6) writing the research report (Braun & Clarke, 2006). In this respect, clusters of related themes were examined within the data set and two major themes were produced as the end of the data analysis: "the nature of socioscientific issues" and "educational use of socioscientific issues".

Quantitative Strand

Samples

Sometimes mixed methods researchers work on completely different samples in qualitative or quantitative strands of their research. However, a good mixed methods research is carried out on different samples selected from within the same population at every stage. At this point, researchers should be careful not to involve the same individuals into both samples (Creswell, 2014). In this respect, no sampling strategy was used and all prospective teachers other than the ones participating in the qualitative strand of the study were invited to participate in the quantitative strand of the study. A total of 113 prospective teachers other than those participated in semi-structured interviews agreed to participate in the study. Demographics of prospective teachers participating in the quantitative strand are presented in Table 1.

Table 1. Demographics of the participants attending the quantitative strand

Variables	***f***	**%**
Gender		
Woman	68	60.2
Man	44	38.9
Missing data	1	.9
Grade average		
2.99 and below	68	60.2
Between 3.00-4.00	44	38.9
Missing data	1	.9
Total	**113**	**100**

Among the participants 60.2% were female and 38.9% were men. On the other hand, 60.2% of them had 2.99 or lower GPAs and 38.9% had a GPA between 3:00 and 4:00. One participant did not answer questions about gender and GPA.

Collection and analysis of data

Quantitative data were collected using "Socioscientific Issues in Science Course Questionnaire", which was developed by the researcher. To develop the questionnaire items, firs the literature was examined. In this context, an item pool was formed using the questionnaire forms used in Lee et al. (2006) and Kara (2012). Relevant items were evaluated by the researcher in terms of content and those items which are not compatible with the research questions, not clearly understood, not specific to the topic, and contain multiple statements, were discarded. The draft questionnaire form was consulted to an expert panel to check its content validity and necessary corrections were made in accordance with the feedback received. To test the intelligibility of the questionnaire form, a pilot study was conducted with 52 students in the Elementary Science Education Program and after necessary modifications were made questionnaire preparation process was finalized.

The questionnaire was used as a structured written interview form to obtain participants' views about SSI. In this respect, since it is not proper to refer to any internal reliability or construct validity to estimate a total score as in the scales (Erkus, 2011), no reliability coefficient estimation or factor analysis were done on the questionnaire items.

The questionnaire was composed of three parts. In the first part, there were two questions asking for the prospective teachers demographics. In the second section, there was a supplementary knowledge which describes the characteristics of SSI with examples. The third part consists of 13 items asking for prospective teachers' views about SSI. Prospective teachers were asked to select one of the responses including "strongly disagree," "disagree," "undecided", "agree" or "strongly agree". Participants completed the questionnaires during their regular classes.

The data obtained from the quantitative strand of the research was analyzed using frequency, percentage, and mean scores. Chi-squared test was used in order to test weather prospective teachers' views on SSI differ by gender and academic achievement scores (Buyukozturk, 2005; Tabachnick & Fidell, 2000).

Findings

Findings were presented below under two sections as required by the mixed methods design.

The findings of the qualitative strand of the research

The nature of socioscientific issues

The participants described the SSI as the current events which affect individuals, have no consensus on, include understanding the risks and probabilities, are structured in the form of open-ended dilemmas, necessitate moral and ethical choices to be made, have more than one alternative solutions (having no definite solution, however).

Sophia described SSI as issues, which emerge as a result of scientific developments and affect individuals in a society. Sophia puts her thought in more detailed way as follows: "SSI are the ones with scientific basis existing in a society. They are the issues directly or indirectly affect the society."

Jackson regards SSI as the issues with no consensus on. To him, the SSI are related with understanding certain risks and possibilities. He comments on the issue as: "SSI are the issues whose pros and cons have been discussed for some time, and hardly any conclusion was made upon". Emma also referred to the aspects of SSI in terms of understanding the risks and possibilities, stating that "SSI are the ones about which everybody has some knowledge, but no consensus has been established about the benefits and costs." Emma did not mention about the controversial nature of SSI in terms of understanding the risks and possibilities alone. In addition, it is remarkable that she put that individuals in the society are aware of these issues and are informed, through limited, about these issues. Olivia also stated supporting ideas. She stated that SSI are "the ones on which everyone have some idea, about which one can talk in a classroom or community. Generally it is a current issue". Olivia also mentioned that everybody knows about the SSI, as suggested in the previous thought. On the other hand, she also recognized the social impact of these problems. This is because SSI are not only a tool to be used in instructional educational environment, but they are also important in everyday social relations of individuals in a society. Another important emphasis was on the actuality of the SSI. Participants were observed to refer frequently to their in-class experiences while voicing their views. The fact that participants voice similar views may suggest that they gain similar learning outcomes from in-class practices.

Ava noticed that SSI involve certain uncertainties and thus they have no definite solutions. Similarly, Ava argued that SSI often arise in the form of media news, stating that "I believe that they are the issues that media publicizes to some extent and on which we cannot make to a definite conclusion." Similarly, Isabella mentioned that SSI emerge in the form of media news, stressing that individuals are informed about them via Internet and social networks.

Unlike other participants Jackson was no mention that requires ethical choices of SSI. To him, contemporary developments in science and technology are threatening the future of the humankind, because human life is entirely built on mobile phones, computers and other smart systems and they are likely to threaten the future of human existence. He explains that "Google has purchased a robot company... For example, some think that eventually the future will turn out to be a land of robots and robot fights. Above all, if you make robots become completely human-like, thinking and acting like humans, they could become a threat to the human race in the future." Therefore, he believes that integrating SSI into science lessons would enable students contemplate on the ethical consequences of the scientific and technological application.

Two of the participants, Sean and Connor, defined the SSI as scientific events. Sean stated that "... a socioscientific issue is a scientific event concerning normal people. Scientific event which interests people." Connor on the other hand explained a socioscientific issue as "a scientific event which affects our lives, our being, that is our social life, and the world universally". SSI are the dilemmas concerning economy, environment, politics, moral and ethical subjects, and bears in conflicts at least in one of these fields. As a matter of fact, while scientific developments emerge as the activities of scientists, SSI are the problems are outside the scope of the world of science and they have been debated for long and affecting the daily life of an ordinary individual. In this sense, it can be asserted that Sean and Connor fall into a misconception in defining SSI as "scientific events".

Educational use of socioscientific issues

Participants expressed their views about the benefits of using SSI in science teaching and teacher roles under the theme of educational use of SSI. Participants believed that the benefits of SSI are closely related with providing students with higher order thinking skills. In this respects, they stated that SSI can have students gain such higher order thinking skills as argumentation, opinion development, scientific process skills and creativity. Likewise, they thought that, though limited, integrating SSI into science teaching can help students think on their citizenship responsibilities.

Sean expresses his point about the positive contribution of use of SSI on students' argumentation ability as such: "For example, I think differently about nuclear energy. I believe they should be built. However, if one of my friends who opposes nuclear power plants can make a pretty good argumentation, I can be convinced (...) I may change my mind finding his arguments wise." To Sean, discussing the SSI in class necessitates the students to use information resources to create the necessary basis for their opinion. Thus, evidence-based discussions by the students becomes a means of analyzing different views, and evaluating and developing opinions. Similarly, Olivia associated the use of SSI in science lessons with the creation of argumentation and development of opinions. She believes that in order to engage in class discussions and create a foundation for the defended opinion, students would read scientific articles, and be able to disprove each other's thesis during the class discussions and sometimes the processes may end up with the development of the initial opinion, i.e. adoption of the opposing opinion. Olivia puts in her thoughts as follows:

"We read an article before coming to the class. I was indecisive about whether nuclear power plants should be founded or not, but after I read the article I dominantly got idea that they should be built. While listening to the opponents' ideas, you may learn something new or the opposite party can disprove your thesis (...) You can adopt opposite views. There may be such changes in your opinion."

Connor claimed that SSI cannot be taught directly saying "we are not going to tell these directly. We have to provide students with perspectives, scientific perspectives, about SSI. Hence, it can be asserted that Connor accepts SSI not as an educational goal, but as a context to be used to achieve a goal. Emma believes that SSI help students gain scientific thinking skills, explaining that "Scientific process skills can be improved, and children's thinking skills can be improved." Similarly, Sophia believes that SSI should be used to develop reasoning ability among students and to help them notice different viewpoints. Jackson and Sean highlighted that integrating SSI into lessons can work in maximizing the imagination and creativity of the students.

Ava believes that SSI may help the students contemplate on their individual responsibilities as good citizens. Ava pointed that SSI such as genetically modified foods, organ transplantation, global warming, nuclear power plants can be used in science education and these issues can lead the learners inquiry the answers of such questions as "What is my responsibility in this issue? What would be my responsibility? What can I do myself in this matter?"

Participants also stated that teachers should have certain roles in the course of using SSI in science education. According to the participants, teachers should have content knowledge, not impose their views on students, guide students, lead the discussions, select challenging problems for the students, get prepared before the lessons, ask intriguing and thought-provoking questions. So, according to the views of the participants, teachers should have content knowledge about SSI, as well as the pedagogical competence that accompanies this content knowledge. Emma points out that a teacher needs to have content knowledge, if she is to integrate SSI into science lessons. To her, a teacher's role as a guide requires making necessary explanations, offering resources for the students to acquire knowledge and being impartiality. She expresses her views on this issue as follows:

"I think teachers should play the role of guide, just like you. She should not disclose her opinion first, but listen to students. (...) The teacher should give information on some issues as you do. (...) I would give resources about the topics in advance, and ask students to explore the topic in advance. "

Sean also believes teachers should tell their views while discussing the socioscientific discussing issues. He justifies himself stating that "Because every student imitate their teachers." Also Sean emphasized the importance of traditional role of teachers as "the transferor of knowledge". However, he stressed the importance of the information given to the students should not be in the form of a detailed presentation, but the students should discover the details. Following is Sean's other views on the use of SSI:

"While selecting the topics, everything should be considering including students' age, level and context. If we bring in a big socioscientific problem for student discussion, let alone improving students' problem solving abilities, they cannot even speak as they are shocked. This is because they cannot find any views."

Olivia emphasizes the need that teachers should select topics suitable for learners' level, while Isabella mentioned that the language used should be appropriate for student's level. While Ava points out that teachers should arrange their questions very well before the lesson, Sophia associated teacher roles with the characteristics of SSI, explaining that "Since these subjects are open-ended, teachers should set a framework. Teachers should guide students well. Teachers should be guiding their students, but should not express a definite opinion. Students should ask the students to freely defend and express their opinions."

As it is understood, almost all of the participants emphasized the guidance role of the teachers, and stated that especially in classes with young students, teachers have the responsibilities to access to resources, to lead to class discussions, to redirect the discussion when students deviate from the subject and to make theoretical explanations to some extent.

The findings relating to the quantitative strand of the research

Participants views about the use of socioscientific issue in primary science education

Participants commented on the use of SSI in primary science education by responding to the questionnaire items. The participants' responses for each item are presented in Table 3.

Table 3. *Participants' views on the characteristics of SSI*

			Strongly Disagree	Disagree	Indecisive	Agree	Strongly Agree	*M*
1)	Successful students would be more interested in SSI in science lessons.	*f*	13	39	16	40	3	2.82
		%	11.7	35.1	14.4	36.0	2.7	
2)	Elementary students are not mature enough to be interested in SSI.	*f*	6	39	31	28	8	2.93
		%	5.4	34.8	27.7	25.0	7.1	
3)	Science lessons are more suitable for SSI than other lessons.	*f*	4	9	19	58	19	3.72
		%	3.7	8.3	17.4	53.2	17.4	
4)	Integrating SSI into science lessons is not compatible with the essence of science course.	*f*	28	63	11	6	3	2.03
		%	25.2	56.8	9.9	5.4	2.7	
5)	Teachers are not competent in integrating SSI in science lessons.	*f*	2	18	38	46	8	3.35
		%	1.8	16.1	33.9	41.1	7.1	
6)	It is hard for primary students to understand SSI.	*f*	4	30	17	37	3	3.05
		%	4.4	33.0	18.7	40.7	3.3	
7)	Integrating SSI would increase the primary students' interest in science lessons.	*f*	2	11	19	63	18	3.74
		%	1.8	9.7	16.8	55.8	15.9	
8)	Teachers can answer easily the student questions about, SSI.	*f*	2	23	36	45	6	3.26
		%	1.8	20.5	32.1	40.2	5.4	
9)	Prospective teachers should be trained about SSI.	*f*	4	3	3	54	43	4.15
		%	3.6	2.7	7.1	48.2	38.4	
10)	Integrating SSI into science education would increase scientific literacy.	*f*	6	9	9	56	32	3.88
		%	5.4	8.0	8.0	50	28.6	
11)	Integrating SSI into science education means simplifying science education.	*f*	18	37	28	25	5	2.66
		%	15.9	32.7	24.8	22.1	4.4	
12)	I think primary school students can learn science better by discussing SSI.	*f*	3	10	14	66	19	3.78
		%	2.7	8.9	12.5	58.9	17.0	
13)	SSI should definitely be involved in science lessons.	*f*	3	5	13	55	37	4.04
		%	2.7	4.4	11.5	48.7	32.7	

An analysis of the Table 3 reveals prospective teachers have positive views on the use of SSI in science education and tend to strongly agree to the relevant items. The item that participants agreed the most was "Prospective teachers should be trained about SSI" (*M* = 4.15). Accordingly, it can be understood that prospective teachers have highly in need of being trained about SSI. Despite this educational need, prospective teachers seem to believe in the importance of integrating SSI in science lessons. This judgement is supported by the following findings:

"SSI should definitely be involved in science lessons." (*M* = 4:04), "Integrating SSI into science education would increase scientific literacy." (*M* = 3.88), "I think primary school students can learn science better by discussing SSI." (*M* = 3.78) and "Integrating SSI would increase the primary students' interest in science lessons." (*M*=3.74). According to these findings, it can be stated that prospective teachers think that integrating SSI into science education would increase students' interest in learning science, facilitate learning science, and improve scientific literacy.

On the contrary, it was seen that prospective teachers agreed less with the negative statement about the integration of SSI into science education. Among them the item participants agreed relatively the least was “Integrating SSI into science lessons is not compatible with the essence of science course.” (M = 2.03). In other words, it can be said that participants do not find it incompatible with the nature of science education to integrate SSI into science education. Another item that prospective teachers agreed rather at a low level was "Integrating SSI into science education means simplifying science education." (M = 2.66). However, it is a remarkable finding that while participants generally agreed at a low level to this item, about one third of them agreed that “Integrating SSI into science education simplifies science education” and a good number of them (24.8%) were indecisive about this issue. Other items which the participants had rather low levels of agreement included "Successful students would be more interested in SSI in science lessons.” (M = 2.82), "Elementary students are not mature enough to be interested in SSI." (M = 2.93) and "It is hard for primary students to understand SSI." (3.05), respectively.

Prospective teachers’ views about SSI according to their gender and academic achievement

Chi-square test was used to find whether prospective teachers’ views on the SSI differ significantly according to their gender and academic success. However, since in the first attempt the number of cells which had expected count less than five exceeded 20% of total number of cells, some categories were merged and the chi-square analysis was repeated (Buyukozturk, 2005). For this purpose "strongly agree" and "agree" categories were merged under "agree" category, and "strongly disagree" and "disagree" categories were merged under "disagree" category.

As a result of the chi-square analysis for gender variable, a significant difference was found only for the item “Elementary students are not mature enough to be interested in SSI” [$X^2(2) = 6.51$, $p = .038$]. The analysis revealed that 25.6% of the male participants and 50% of the female participants disagreed with this item. Thus, it can be said that female prospective teachers believe that elementary students are mature enough to be interested in SSI more that male prospective teachers do.

Chi-square test results revealed significant differences only for three items in terms of academic achievement. The first item with significant difference was “Successful students would be more interested in SSI in science lessons.” [$X^2(2) = 8.93$, $p = .01$]. The analysis proved that 41.8% of the prospective teachers who had 2.99 and lower average scores and 32.6% of the prospective teachers who had 3 and above average scores stated that successful students would be more interested in SSI in science lessons. This finding suggests that participants with 2.99 and below average scores believe more strongly that successful students would be more interested in SSI in science lessons. The second item with significant difference was “Integrating SSI would increase the primary students’ interest in science lessons.” [$X^2(2) = 6.42$, $p = .04$]. The analysis proved that 6.8% of the prospective teachers who had 2.99 and lower average scores and 23.5% of the prospective teachers who had 3 and above average scores were indecisive about statement that integrating SSI would increase the primary students’ interest in science lessons. This finding suggests that participants with 2.99 and below average scores are more decisive about the statement that integrating SSI would increase the primary students’ interest in science lessons.

The last item with significant difference was “Teachers can answer easily the student questions about, SSI.” [$X^2(2) = 6.37$, $p = .04$]. The analysis proved that 51.5% of the prospective teachers who had 2.99 and lower average scores and 34.9% of the prospective teachers who had 3 and above average scores agreed that teachers can answer easily the student questions about, SSI. This finding suggests that compared to participants with 2.99

and below average scores, those prospective teachers who had 3 and above average scores agreed more strongly that teachers can answer easily the student questions about, SSI.

Results, Conclusions and Recommendations

It is of great importance for the student to learn to make decisions based on the information in SSI to achieve the goal of scientific literacy (Sadler, 2004). It is the responsibility of the teachers to teach scientific literacy to students in a broader sense, and to teach how to think through SSI in a narrower sense. In this respect, the present study aimed to explore the views of prospective elementary school teachers' about SSI. The results obtained from this study are valuable in producing principles in terms of teaching SSI at elementary school.

It was concluded in this study that prospective teachers described the SSI as current events which affect individuals, have no consensus on, include understanding the risks and probabilities, are structured in the form of open-ended dilemmas, necessitate moral and ethical choices to be made, have more than one alternative solutions, but having no definite solutions. These results have both similarities and differences with the findings of previous research in the literature. For example, the participants in Ekborg et al. (2013)'s study also assessed SSI as a current and interesting context. However, unlike their research findings, present study found that participants mentioned that SSI have scientific basis, they require an understanding of the risks and possibilities, and they incorporate ethical dilemmas, though to a limited extent. SSI arise on the basis of developments in science and technology, but their solutions require not only thinking scientifically but also considering the ethical and moral values. Therefore, when faced with any SSI, it is useful for the students or regular citizens to consider the ethical problem or problems inherent in the structure of the relevant socioscientific issue. This is because the active citizens of the future are expected to interpret the possible outcomes of the relevant SSI based on certain ethical and moral principles.

In the qualitative strand of the study, only one participant mentioned about the ethical characteristics of the SSI. Accordingly, it can be asserted that the participants are not aware of the moral and ethical values to be considered during the decision making process concerning the SSI. However, the opportunity to make choices in terms of ethical and moral issues concerning the SSI have been studied directly or indirectly in many research studies (Barrett & Nieswandt, 2010; Fleming, 1986; Sadler & Zeidler, 2004; Topcu et al. 2011). For example, Sadler & Zeidler (2004) examined how prospective teachers interpret SSI within the context of genetic engineering and found out that moral factors have important impact in decision-making processes regarding genetic engineering. Topcu et al. (2011) found out that moral and ethical considerations were one of the components which affect the informal reasoning processes. Fleming (1986) also concluded that moral issues are important in students' decision-making processes. The literature reveals that students' decision-making process concerning the SSI is a highly complex situation. Students' decision-making process cannot be explained by scientific knowledge alone. It should be noted that personal experiences, values, social and epistemological issues are also important beside scientific knowledge.

It was also found that belief systems or religious properties, which are important agents of reasoning processes regarding SSI has not been mentioned at all. However, previous research findings suggest that individuals' characteristics derived from their belief systems are effective on their way of thinking about their SSI (Sadler & Donnelly, 2006; Topcu et al., 2011; Zeidler et al, 2013). Sadler and Donnelly (2006) argue that rating ethical judgements regarding the SSI are affected from individuals' religious point of view. In the relevant research, half of the participants stated that religious belief is an important factor. Zeidler et al. (2013) posits that throughout the history belief system have always been effective in peoples' discourses and reasoning about the SSI. This is because theological overtones do seem to be driven by the belief that humans are fulfilling a divine plan that implicitly removes one from the tacitly taking responsibility for a given decision. At this point arises the influence of beliefs in reasoning process about SSI. In the judgment process based on beliefs, individuals tend to merge religious beliefs with scientific data or explanations. People certainly are affected by the belief systems which are the product of culture and society. These systems affect individuals' reasoning and decision-making processes while forming their judgements of what is right, wrong, good and evil. In this context, what matters is not to evaluate SSI with the characteristics of moral, ethical, and belief systems alone, but to do so considering scientific, economic and political components.

The present study also found that socioscientific events are referred to as "scientific events". SSI are the dilemmas concerning economy, environment, politics, moral and ethical subjects, and bears in conflicts at least in one of these fields. As a matter of fact, while scientific developments emerge as the activities of scientists, SSI are the problems are outside the scope of the world of science and they have been debated for long and affecting the daily life of an ordinary individual. In this sense, it can be asserted that some of the participants' fall into the misconception in defining SSI as "scientific events". As specified by Eastwood et al. (2012) for a problem to be named socioscientific, it is content must be based on scientific development, but it must also be meaningful socially.

Both qualitative and quantitative strands of the research revealed that participants believe SSI help primary school students gain higher order thinking skills. In this context, it was understood that participants believe science education involving SSI can have students gain such higher order thinking skills as argumentation, opinion development, scientific process skills and creativity. While this finding overlaps with some previous research findings in the literature (Dawson & Venville, 2013; Dolan, Nichols & Zeidler, 2009; Gresch et al., 2013; Khishfe, 2014), it also contrasts with some others (Foong & Daniel, 2013). For example, Dawson and Venville (2013) found that using SSI improved the argumentation and informal reasoning skills of the students in the experimental group. Similarly Gresch et al. (2013) have also found that SSI have a positive impact on students' decision-making skills. However, Foong and Daniel (2013) found that in their research that using SSI in certain instructional methods caused some progress in the argumentation skills of some students, but not on some others.

It was determined in the present study that instruction based on SSI can improve the citizenship competencies of the students. There are similar findings in the literature. For example, Lee et al. (2013) investigated the impact of instruction based on SSI on the development of favorable characters and values among students as global citizens. The research results indicated that students have developed sensitivity concerning the moral and ethical aspects of scientific and technological developments. The same study also revealed that students developed compassion for the students who are deprived of the benefits of advanced technologies or who suffered the adverse effects those technologies. Also, it was understood that students promised to act more responsively in the future regarding the solution of SSI in the field of genetics. In another study, Lee et al. (2006) found that education based on SSI help the students gain insights about the positive and negative aspects of science as citizens and develop a deep and unbiased understanding of science among students.

It was found that while the using the SSI in science education, teachers "should not impose their views on students, guide students, lead the discussions, select challenging problems for the students, get prepared before the lessons, and ask intriguing and thought-provoking questions". In a research conducted by Van Rooy (1993) it was also reported that teachers should have similar roles. Van Rooy (1993) found that while using the SSI in their classes, teachers play the roles of helping, supporting, facilitating, impartiality, being devil's advocate, and counselling. Zeidler and Nichols (2009) argues that it is important to encourage students to think about alternative evidences. Likewise, it is important for teachers to ask meaningful questions during class discussions and manage class discussions, thus they need to use the research and current information about the SSI discussed. Ekborg et al. (2013) found that science teachers encouraged students to ask questions and answer to these questions, as well, arrange class debates, and perform web quests. Foong and Daniel (2013) indicated that teachers played the facilitator role instead of the traditional role of transferor or knowledge. Throughout the study teachers refrained from affecting their students' decisions, thus they neither supported nor rejected their decisions.

The results obtained in the present study, as well as the previous research findings suggest that teachers should play the following roles regarding the use of SSI in general: firstly, after the teacher announces the socioscientific issue to be handled in the lesson, she should ensure that students are engaging in reading or inquiring about the relevant issue. In the second stage, teacher should check whether the students have understood the socioscientific issue and answer possible questions from the students. If students need and demand, teacher can give students some information in an objective manner. In this process, teacher's objective attitudes is very important in order not to affect students' assertions. After fulfilling these roles described, teacher should ask the students to express their viewpoints about the SSI justifying their assertions and supporting arguments. At the final stage, after listening to the explanations of each of the volunteering students, teacher should ask other students or the student who explained his/her view earlier to express opposite ideas which would disprove the initial views of their own or friends again with supportive ideas or arguments. On the condition that instruction is conducted in accordance with these steps, a teacher can improve the thinking skills of students and have the students discover scientific, political, personal, social, economic, religious, moral and ethical characteristics inherent in the SSI.

It was found in the present study that prospective teachers believed that SSI would increase the interests of students in science classes. This result is in agreement with other research findings in the literature (Anagun & Ozden, 2010; Ekborg et al., 2013; Kara, 2012; Lee et al., 2006; Ottander & Ekborg, 2012). The key for the students to understand science courses effectively and bear more responsibility in their lessons is their interest into the science. Therefore current and dynamic topics like SSI can be used as an instrument to increase the students' interest into the content of the course by making it easier for the students easier to establish a link between the real-life and the lessons

Like many studies in the relevant literature (Anagun & Ozden, 2010; Ekborg et al., 2013; Kara, 2012; Lee et al., 2006), the present study showed, too, that prospective teachers have training needs regarding SSI. However, the dimensions of these training need are not known well. In general, competencies of teaching profession include learning and teaching process, monitoring and assessing student learning, school-family and social relationships, curriculum and content knowledge. It is important to determine in which field(s) the prospective elementary school teachers have training needs. On the other hand, there are research findings indicating that prospective teachers have positive perceptions of competency. For example Kilinc et al. (2013) found that prospective science teachers found themselves efficient to teach SSI. Researchers also detected that underlying reasons for the strong content knowledge of the prospective teachers include their undergraduate courses, informal environment, and participants' personal interest in food technology. While content knowledge is undoubtedly important for effective teaching, it is not possible to acknowledge it as the only and most important condition due to some limitations. For an effective teaching one should have curriculum knowledge, competence in teaching methods and techniques, good command on the assumptions of development and learning psychology, as well as know how to measure and evaluate. However, the importance of the content knowledge cannot be denied. As a matter of fact, Sadler & Zeidler (2005b) also revealed that individuals with rich content knowledge face fewer problems during informal reasoning compared to those with poor content knowledge. It can be claimed that the most important component affecting the individuals' perceptions of their competencies is content knowledge. The participants of the present research comprise prospective elementary school teachers. It is possible that since prospective elementary school teachers do not acquire in-depth knowledge about a particular discipline, lack of content knowledge may have a negative effect on their perceptions of competence.

Participants believe that elementary school students are mature enough to understand SSI. There are example researches in the literature proving that SSI can be used with younger age groups (Dolan et al., 2009; Pedretti, 1999; Ritchie et al., 2011; Rose & Barton, 2012). For example, Dolan et al. (2009) presented some sample activities in which SSI can be used with the fifth grade students and concluded that SSI improve learners' scientific literacy. Ritchie et al. (2011) found that in the science lessons where the SSI were used, students aged eleven showed significant improvement in terms of scientific content, with increased levels of interest and self-efficacy regarding the science lesson. In another study Pedretti (1999) revealed the fifth and sixth grade students can improve their critical thinking and decision-making skills if faced with SSI.

Unlike the research findings above, some research (Ekborg et al., 2013; Lee et al., 2006; Ozden, 2011) found that participants, though a few, consider the immaturity of the students as an obstacle for the use of SSI. For example Ekborg et al. (2013) reported that some teachers believe that it is difficult for students aged 13-16 to work on SSI. According to the teachers, students from this age range have difficulty in focusing on specific questions and understanding the respective tasks. Similarly, Ozden (2011) reported that one participant of his research believed elementary school students would have difficulty in understanding the SSI. At this point, what matters is to decide how SSI can be used so as to contribute to the developmental features of the students at each class level, but not whether SSI can be used with certain age groups or not. Teachers are responsible to design activities in which students will enjoy learning, discussing, and involving into the SSI, considering the characteristics of the age group.

It was also found that participants in the present study believed that integrating SSI into science education would improve the scientific literacy of the students. There is evidence in the literature suggesting that using SSI in science education improve the learners' scientific literacy. For example, Ritchie et al. (2011) reported improved levels of scientific literacy on the part of learners who participated into scientific writing activities where SSI were used. It is important to use SSI in science lessons as an instrument to achieve the goal of scientific literacy. Therefore, while the information and resources to be used by the teachers are important, what matters more is to provide prospective teachers with an understanding of how to teach scientific literacy using the SSI and to develop teaching skills through example practices. Moreover, science curriculum should include the reflections of the features of SSI for scientific literacy.

In the study, it was found that prospective teachers with low academic achievement believed successful students would be interested in the SSI more. This result is very important. As discussed earlier, learners should have adequate level of knowledge in order to make reasoning against SSI. Prospective teachers with low academic achievement might have remembered the problems they faced during the sessions where SSI were discussed, and reflected that rather successful students would attend the discussion about SSI. On the other hand, SSI does not address to a particular group of students. Unlike the findings of the present study, Lee et al. (2006) found that teachers believed that not only the successful students, but all students would benefit from the SSI. It was found that male and female participants' views differed significantly only for one item. Accordingly, female prospective teachers believed more strongly than the male ones that elementary students are mature enough to be interested in SSI. The absence of any significant differences for other items is in agreement with the research findings in Kara (2012).

Present research has some limitations. First, the research is limited with the views and experiences of the prospective elementary school teachers studying at a university. Thus, this limitation should be considered while making generalizations. Also in the future, a qualitative research can be done in order to understand how (prospective) elementary school teachers integrate SSI in to their learning-teaching process; and a quantitative research can be done to determine (prospective) elementary school teachers' senses of self-efficacy in teaching SSI. Similarly, future researches can be done to explore prospective elementary school teachers' epistemological patterns about SSI.

• • •

References

Alacam-Aksit, A. C. (2011). Sınıf öğretmeni adaylarının sosyobilimsel konularla ve bu konuların öğretimiyle ilgili görüşleri. (Yüksek lisans tezi). https://tez.yok.gov.tr/UlusalTezMerkezi/SearchTez adresinden alınmıştır.

Albe, V. (2008). Students' positions and considerations of scientific evidence about a controversial socioscientific issue. Science & Education, 17, 805-827. doi: 10.1007/s11191-007-9086-6.

American Association for the Advancement of Science. (2009). Benchmarks for science literacy. Retrieved from http://www.project2061.org/publications/bsl/online/index.php

Anagun, S. S. & Ozden, M. (2010). Teacher candidates' perceptions regarding socio-scientific issues and their competencies in using socio-scientific issues in science and technology instruction. Procedia - Social and Behavioral Sciences, 9, 981-985.

Ayres, L. (2008). Thematic coding and analysis. In L. M. Given (Ed.), The SAGE Encyclopedia of Qualitative Research Methods (pp. 867-868). Thousand Oaks, CA: Sage.

Barrett, S. E. & Nieswandt, M. (2010). Teaching about ethics through socioscientific issues in physics and chemistry: Teacher candidates' beliefs. Journal of Research in Science Teaching, 47(4), 380-401.

Barrue, C. & Albe, V. (2013). Citizenship education and socioscientific issues: Implicit concept of citizenship in the curriculum, views of French middle school teachers. Science & Education, 22, 1089-1114. doi: 10.1007/s11191-012-9571-4

Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77-101. doi:10.1191/1478088706qp063oa

Buyukozturk, S. (2005). Sosyal bilimler için veri analizi el kitabı. (5. Baskı). Ankara: Pegem Yayıncılık.

Byrman, A. (2006). Mixed methods: A four-volume set. Thousands Oaks, CA: Sage.

Creswell, J. W. & Plano Clark, V. L. (2011). Designing and conducting mixed methods research. (2nd Edition). Thousands Oaks, CA: Sage.

Creswell, J. W. (2014). Research design: Qualitative, quantitative, and mixed methods approaches. (4th Edition). Thousand Oaks: Sage.

Creswell, J. W. (2015). A concise introduction to mixed methods research. Thousand Oaks: Sage.

Dawson, V & Venville, G. (2013). Introducing high school biology students to argumentation about socioscientific issues. Canadian Journal of Science, Mathematics and Technology Education, 13(4), 356-372. doi: 10.1080/14926156.2013.845322

Dawson, V. (2001). Addressing Controversial Issues in secondary school science. Australian Science Teachers Journal, 47(4), 38-44.

Day, S. P. & Bryce, T. G. K. (2011). Does the discussion of socio-scientific issues require a paradigm shift in science teachers' thinking? International Journal of Science Education, 33(12), 1675-1702.

Dolan, T. J., Nichols, B. H., & Zeidler, D. L. (2009). Using socioscientific issues in primary classrooms. Journal of Elementary Science Education, 21(3), 1-12.

Eastwood, J. L., Sadler, T. D., Zeidler, D. L., Lewis, A., Amiri, L., & Applebaum, S. (2012). Contextualizing nature of science instruction in socioscientific issues. International Journal of Science Education, 34(15), 2289-2315. doi: 10.1080/09500693.2012.667582

Ekborg, M. , Ottander, C., Silfver, E. & Simon, S. (2013). Teachers' experience of working with socio-scientific issues: A large scale and in depth study. Research in Science Education, 43(2), 599-617. doi: 10.1007/s11165-011-9279-5

Erkus, A. (2011). Davranış bilimleri için bilimsel araştırma süreci. (3. Baskı). Ankara: Seçkin Yayıncılık.

Firmin, M. W. (2008). Themes. In L. M. Given (Ed.), The SAGE Encyclopedia of Qualitative Research Methods (pp. 868-869). Thousand Oaks, CA: Sage.

Fleming. R. (1986). Adolescent reasoning in socio-scientific issues, part I: Social cognition. Journal of Research in Science Teaching, 23(8), 677-687.

Foong, C.-C., & Daniel, E. G. S. (2013). Students' argumentation skills across two socio-scientific issues in a Confucian classroom: Is transfer possible? International Journal of Science Education, 35(14), 2331-2355. doi: 10.1080/09500693.2012.697209

Gibson, W. J. & Brown, A. (2009). Working with qualitative data. London, Thousand Oaks: Sage.

Gresch, H., Hasselhorn, M. & Bögeholz, S. (2013). Training in decision-making strategies: An approach to enhance students' competence to deal with socio-scientific issues. International Journal of Science Education, 35(15), 2587-2607. doi: 10.1080/09500693.2011.617789

Ideland, M., Malmberg, C., & Winberg, M. (2011). Culturally equipped for socio-scientific issues? A comparative study on how teachers and students in mono- and multiethnic schools handle work with complex issues. International Journal of Science Education, 33(13), 1835-1859. doi: 10.1080/09500693.2010.519803

Jones A., Buntting, C., Hipkins, R., McKim, A., Conner, L. & Saunders. K. (2011). Developing students' futures thinking in science education. Research in Science Education, 42(4), 687-708.

Kara, Y. (2012). Pre-service biology teachers' perceptions on the instruction of socio-scientific issues in the curriculum. European Journal of Teacher Education, 35(1), 111-129. doi: 10.1080/02619768.2011.633999

Khishfe, R. (2012). Relationship between nature of science understandings and argumentation skills: A role for counterargument and contextual factors. Journal of Research in Science Teaching, 49(4), 489-514.

Khishfe, R. (2014). Explicit nature of science and argumentation instruction in the context of socioscientific issues: An effect on student learning and transfer. International Journal of Science Education, 36(6), 974-1016. doi: 10.1080/09500693.2013.832004

Kilinc, A., Kartal, T., Eroglu, B., Demiral, U., Afacan, O., Polat, D., Demirci Guler, M. P. & Gorgulu, O. (2013). Preservice science teachers' efficacy regarding a socioscientific issue: A belief system approach. Research in Science Education, 43(6), 2455-2475. doi: 10.1007/s11165-013-9368-8

Kolstø, S. D. (2001). Scientific literacy for citizenship: Tools for dealing with the science dimension of controversial SSI. Science Education, 85(3), 291-310. doi: 10.1002/sce.1011

Kolstø, S. D., Bungum, B., Arnesen, E., Isnes, A., Kristensen, T., Mathiassen, K. & et al. (2006). Science students' critical examination of scientific information related to socioscientific issues. Science Education, 90(4), 632-655.

Lee, H., Abd-El-Khalick, F. & Choi, K. (2006) Korean science teachers' perceptions of the introduction of socio-scientific issues into the science curriculum. Canadian Journal of Science, Mathematics and Technology Education, 6(2), 97-117. doi: 10.1080/14926150609556691

Lee, H., Yoo, J., Choi, K., Kim, S.-W., Krajcik, J., Herman, B. C., & Zeidler, D. L. (2013). Socioscientific issues as a vehicle for promoting character and values for global citizens. International Journal of Science Education, 35(12), 2079-2113. doi: 10.1080/09500693.2012.749546

Levinson, R. (2006). Towards a theoretical framework for teaching controversial socio-scientific issues. International Journal of Science Education, 28(10), 1201-1224.

Ministry of National Education [Milli Egitim Bakanlıgı] (2013). İlköğretim kurumları (ilkokullar ve ortaokullar) fen bilimleri dersi (3, 4, 5, 6, 7 ve 8. sınıflar) öğretim programı. Ankara: Talim Terbiye Kurulu Başkanlığı.

Morris, H. (2014). Socioscientific issues and multidisciplinarity in school science textbooks. International Journal of Science Education, 36(7), 1137-1158. doi: 10.1080/09500693.2013.848493

Morse, J. M. (1991). Approaches to qualitative-quantitative methodological triangulation. Nursing Research, 40(1), 120-123.

National Research Council (1996). National science education standards. Washington, DC: National Academies Press.

Ottander, C. & Ekborg, M. (2012). Students' experience of working with socioscientific issues: A quantitative study in secondary school. Research in Science Education, 42, 1147-1163. doi: 10.1007/s11165-011-9238-1

Ozden, M. (2011). 4. ve 5. sınıflar fen ve teknoloji dersinin vatandaşlık eğitimi bakımından işlevselliği. (Yayınlanmamış doktora tezi). Anadolu Üniversitesi Eğitim Bilimleri Enstitüsü, Eskişehir.

Patton, M. Q. (2001). Qualitative research and evaluation methods. (3rd Ed.). Thousand Oaks: Sage.

Pedretti, E. (1999). Decision making and STS education: Exploring scientific knowledge and social responsibility in schools and science centers through an issues-based approach. School Science and Mathematics, 99(4), 174-181. doi: 10.1111/j.1949-8594.1999.tb17471.x

Pedretti, E. (2003). Teaching science, technology, society and environment education: Preservice teachers' philosophical and pedagogical landscapes. In D. L. Zeidler (Ed.), The role of moral reasoning on socioscientific issues and discourse in science education (p.219-239). London: Kluwer Academic Publishers.

Ritchie, S. M., Tomas, L. & Tones, M. (2011). Writing stories to enhance scientific literacy. International Journal of Science Education, 33(5), 685-707. doi: 10.1080/09500691003728039

Rose, S. L. & Barton, A. C. (2012). Should great lakes city build a new power plant? How youth navigate socioscientific issues. Journal of Research in Science Teaching, 49(5), 541-567. doi: 10.1002/tea.21017

Rudsberg, K., Öhman, J. & Östman, L. (2013). Analyzing students' learning in classroom discussions about socioscientific issues. Science Education, 97(4), 594-620. doi: 10.1002/sce.21065

Sadler, T. D. & Donnelly, L. A. (2006). Socioscientific argumentation: The effects of content knowledge and morality. International Journal of Science Education, 28(12), 1463-1488. doi: 10.1080/09500690600708717

Sadler, T. D. (2004). Informal reasoning regarding socioscientific issues: a critical review of research. Journal of Research in Science Teaching, 41(5), 513-536. doi: 10.1002/tea.20009

Sadler, T. D. (2009). Situated learning in science education: Socio-scientific issues as contexts for practice. Studies in Science Education, 45(1), 1-42. doi: 10.1080/03057260802681839

Sadler, T. D., & Zeidler, D. L. (2004). The morality of socioscientific issues: Construal and resolution of genetic engineering dilemmas. Science Education, 88(1), 4-27. doi: 10.1002/sce.10101

Sadler, T. D., & Zeidler, D. L. (2005a). Patterns of informal reasoning in the context of socioscientific decision making. Journal of Research in Science Teaching, 42(1), 112-138. doi: 10.1002/tea.20042

Sadler, T. D., & Zeidler, D. L. (2005b). The significance of content knowledge for informal reasoning regarding socioscientific issues: Applying genetics knowledge to genetic engineering issues. Science Education, 89(1), 71-93. doi: 10.1002/sce.20023

Sadler, T. D., Chambers, F. W., & Zeidler, D. L. (2004). Student conceptualizations of the nature of science in response to a socioscientific issue. International Journal of Science Education, 26(4), 387-409. doi:10.1080/0950069032000119456

Saldaña, J. (2011). Fundamentals of qualitative research: Understanding qualitative research. New York: Oxford University Press.

Saunders, K. J. & Rennie, L. J. (2013). A pedagogical model for ethical inquiry into socioscientific issues in science. Research in Science Education, 43(1), 253–274. doi: 10.1007/s11165-011-9248-z

Seidman, I. (2006). Interviewing as qualitative research: A guide for researchers in education and the social sciences. (3rd ed.). New York: Teachers College Press.

Spradley, J. P. (1979). The ethnographic interview. Florida: Holt, Rinehart and Winston Inc.

Tabachnick, B. G., & Fidell, L. S. (2000). Using multivariate statistics. New York: Allyn & Bacon.

Tashakkori, A., & Teddlie, C. (Eds.). (2010). SAGE handbook of mixed methods in social and behavioral research. (2nd Ed.). Thousand Oaks, CA: Sage.

ten Have, P. (2004). Understanding qualitative research and ethnomethodology. London: Sage Publications.

Tomas, L., Ritchie, S. M. & Tones. M. (2011). Attitudinal impact of hybridized writing about a socioscientific issue. Journal of Research in Science Teaching, 48(8), 878-900. doi: 10.1002/tea.20431

Topcu, M. S. (2010). Development of attitudes towards socioscientific issues scale for undergraduate students. Evaluation & Research in Education, 23(1), 51-67. doi: 10.1080/09500791003628187

Topcu, M. S., Mugaloglu, E. Z., & Guven, D. (2014). Fen eğitiminde sosyobilimsel konular: Türkiye örneği. Kuram ve Uygulamada Eğitim Bilimleri, 14(6), 1-22.

Topcu, M. S., Sadler, T. D. & Yilmaz-Tuzun, O. (2010). Preservice science teachers' informal reasoning about socioscientific issues: The influence of issue context. International Journal of Science Education, 32(18), 2475-2495. doi: 10.1080/09500690903524779

Topcu, M. S., Yilmaz-Tuzun, O., & Sadler, T. D. (2011). Turkish preservice science teachers' informal reasoning regarding socioscientific issues and the factors influencing their informal reasoning. Journal of Science Teacher Education, 22(4), 313-332. doi: 10.1007/s10972-010-9221-0

Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. Nursing and Health Sciences, 15(3), 398–405. doi: 10.1111/nhs.12048

Van Rooy, W. (1993). Teaching controversial issues in the secondary science classroom. Research in Science Education, 23, 317-326.

Yildirim, A., & Simsek, H. (2013). Sosyal bilimlerde nitel araştırma yöntemleri. (9. Baskı). Ankara: Seçkin Yayıncılık.

Zeidler, D. L. & Nichols, B. H. (2009). Socioscientific issues: Theory and practice. Journal of Elementary Science Education, 21(2), 49-58. doi: 10.1007/BF03173684

Zeidler, D. L., Sadler, T. D., Applebaum, S., & Callahan, B. E. (2009). Advancing reflective judgment through socioscientific issues. Journal of Research in Science Teaching, 46(1), 74-101. doi: 10.1002/tea.20281

Zeidler, D., Herman, B. C., Ruzek, M., Linder, A. & Lin, S.S. (2013). Cross-cultural epistemological orientations to socioscientific issues. Journal of Research in Science Teaching, 50(3), 251-283. doi: 10.1002/tea.21077

www.iejee.com

This page is intentionally left blank

International Electronic Journal of Elementary Education, 2015, 7(3), 355-370.

Some Reflections From Pre-Service Elementary Teachers' Practice Teaching on the Area of Understanding Data in the Math-Teaching Course[1]

Özlem DOĞAN TEMUR *
Dumlupınar University, Türkiye

Serap AKBABA DAĞ
Dumlupınar University, Türkiye

Sedat TURGUT
Dumlupınar University, Türkiye

Received: February 2015 / Revised: May 2015 / Accepted: May 2015

Abstract

With developing technology statistical information and data sources become a very important issues and from primary school it has become necessary to gain the skills for making interpreting and making sense of data. These skills consist of collecting information, arrangement and analysis of collected data and the interpretation of the results. The duty of guiding students in their process of making statistical information meaningful falls upon teachers. This study, whose aim was to investigate prepared course content for sub-learning area in grade 1-4 math course and obtained experiences by pre-service elementary teachers in the schools they went as a part of teaching practice course, was conducted with nine fourth-year students attending an undergraduate program of elementary teaching in a state university during 2013-2014 academic year. Pre-service teachers were each asked to prepare and conduct a lesson plan suitable for the lesson outcomes and the level of the classes that they were to teach. Their applications were assessed by semi-structured observation form about data teaching developed by the researchers. It was observed that pre-service teachers could not reflect given lesson outcomes on the topic of data to the lessons they prepared to teach during their teaching practice. In the implementations, it was noted that pre-service teachers could not effectively include students in both collecting and arrangement as well as interpretation processes of the information and that they taught in teacher-centered manner although they prepared a correct activity. It was also noted that pre-service teachers could not well enough differentiate category and concept of variable in table and graph activities.

Keywords: Data instruction, pre-service teacher, teaching practice

---

[1] This paper was presented as the proceedings of the 13th National Symposium of Elementary Teacher Education

* ✉ Özlem Doğan Temur, Dumlupınar University, Kutahya, Turkey. Phone: +90 (274) 422-4602. E-mail: ozlem.dtemur@dpu.edu.tr

ISSN:1307-9298

www.iejee.com

Introduction

Math is not only a field about numbers and calculations but also a system that finds a place in many circumstances encountered in daily life. Developing technology offers a very rich visual world mankind. Maybe, primary school students are the group that spends the most effort trying to explain that visual world. It is because seeing and explaining many elements like figures, numbers, data, words etc. together is a process that have just been learnt. Primary school students will come across graphs and data not only in math lessons but also in science and social sciences and try to set some relationships. Therefore, the topic of data and its teaching is very important from an elementary teachers' point of view. Topıc of a graph in primary school provides an introduction to statistics, another branch of mathematics. Statistics, to answer a question, includes important skills like collecting data, summarizing data, making sense of data, interpreting, concluding for the future and deciding. Acquisition of the skills of data collection, data summation, making sense of data and inference are established as goals in primary schools (Olkun & Toluk Ucar, 2004).

Primary school students should be active in the problem-solving processes (forming questions and their answers, collecting data and its presentation, data analysis, and data inferences) about data. Teachers should encourage students to collect data and interpret them. Studying questions like "Let's assume that," and "What if…happens," provides students to better define the data analysis period and its nature (Franklin & Mewborn 2008). Real world is full of data and its sources. Children need to ask and answer real world questions like 'what?', 'how?', 'when?', 'where?', 'who?', 'why?' to collect data, to organize the data they collected, and to interpret. Therefore, it could be said that data analysis has more significance than in just forming and reading data. Children need to make judgments to collect data. When, at the first stage, facing prompting questions asked by their teachers, children feel a need to collect data. When a teacher says, "I think, plain ice cream would be the most loved ice cream in this class," the children will want to find out what kind of ice cream is the most loved one (Cathart, Pothier, Vance & Bezuk, 2006). Primary school students need to have developed some set of skills to find out the answers of the questions that they are curious about. Acquisition of these sets of basic skills since preschool constitutes an important section of the primary and secondary school mathematics education programs.

Children should come across, since preschool, activities that are aimed to develop the skills of ranking, sequencing, and analyzing. They label the properties of the objects by using characterizations like red, hot and circles. This kind of activities increases the skills of classification and comparison of groups with similarities and differences (Van de Walle, 2010). The first experiences of the students in the topic of data are their encounter with the objects whose properties are easily noticed. These kinds of objects and qualification cards are easy to produce or to obtain by the teachers, too. Some students start by classifying only one property, some can classify according to different properties, too. Teachers should help their students think in different ways when the students classify objects. Venn diagrams are one of the ways that facilitates students' job in classifying multiple properties of the objects. Overlapping circles simplify classifying multiple properties of the objects. Objects that fall outside of the categories will stay outside of the circles (Bahr & Garcia, 2010).

Primary school mathematics education program sees forming problems that could be answered by table or by summarizing in the form of graphs as fundamental purpose of teaching the topic of data. Giving precedence to activities of data, data analysis, simple classification for understanding statistics, comparison, and counting, the mathematics teaching program emphasizes that students form questions, which are meaningful in and of themselves and determine the answers given to those questions, that the students should be directed to organize given answers; and then, that students can present data they collected in both tables and graphs. Examining the data teaching period in the mathematics teaching program, it is seen that reading tables and basic skills about the topic of data are included for first grade; object graphs and table formation in the second grade; figure charts, in which each picture represents one object only or a picture multiple objects in the third grade; formation of bar graphs, organization of data in a table or a graph and data analysis in the fourth grade. The program states that it needs to proceed from pictures to symbols or to more tangible presentations over time [Mathematics (1-5 Grades) Curricula, 2009]. It is attention drawing that the program emphasizes the skills advancing from the abstract to the concrete. The approach of the mathematics teaching program on the topic of data can be seen as an approach that featuring the development of the children's thinking about statistics.

Children's thinking in the topic of statistics can be investigated on four levels. The first level of those is to define data, the second to organize data, the third to present data, and the fourth to analyze and interpret data (Jones, Thornton, Langrall, Mooney, Perry & Putt, 2000). Stating that statistical thinking develops in four periods, Biggs and Collis (1991) define these periods as subjective, transitional, quantitative and analytical. While focusing on their own personal data and trying to make relationships with given data, first-level thinkers are not yet ready to draw conclusions, second-level thinkers start to notice importance of quantitative thinking and are not completely successful, even if they are able to use numbers when performing measurements and trying to make sense of data. The third-level thinkers start to use quantitative thinking, foundation of statistical reasoning, start to acquire the concepts about measures of central tendency, and start to, occasionally though, make relationships between the data and context in which the data are found. The fourth-level thinkers can find the data in their context and make relationships between the data and their context.

When investigating the presentations children use in their demonstrations, five common forms, parallel to development of statistical thinking, can be said to be found. These can be named as dynamic, pictorial, iconic, written and symbolic presentations. While dynamic representations are those with children's movements or acting which children perform live with the object itself, pictorial representations are those formed with the images of real things. Iconic presentations can be considered on the basis of using a sign for every counted unit. Iconic presentations can be considered as tables, but usages of tables are not the only way. It could be said that written presentations like words and sentences that we encounter everywhere all times are also among iconic representations. Children mostly prefer presenting data in written form, for instance, like two grapes as two pieces, four grapes as four pieces. Usages of standard presentations of numbers and signs are now the best examples for iconic presentations (Carruthers & Worthington, 2006).

Acquisition of basic skills on the topic of data will be the foundation to table and graph studies that they encounter in primary schools. Tables are the first tools to be used for organizing data for graphical studies. Tables like frequency tables can be used for organizing data before graph formation activities. It should be primarily decided that what table is needed before graph presentation (Friel, Curcio & Bright, 2001).

Tables are very handy techniques for recording the data. Children should be offered opportunities so that they discover ways of organizing data with table activities (Cathart, Pothier, Vance & Bezuk, 2006).

Children's graph experiences generally advance in four stages. The first period that starts with object graphs is the concrete stage; the one that which object and figure chartss are used together is concrete figure stage; following figure chart studies, the one in which symbolic figures are used instead of real picture of the object is figure-abstract stage; the last one, in which figures in tables and graphs are matched with multiple situations or objects rather than single situation or object is abstract stage (Cathart, Pothier, Vance & Bezuk, 2006). Graphs that are formed with real objects are the first stage of graph studies. Object graph activities should first be performed by using two objects and later more than two objects or situations. After performing these activities, graph studies can be done on the structures formed from lines and columns with the similar structures that can be used instead of real objects (Charlesworth, 2000). Children use some basic skills like counting, comparing, pairing, and classifying. For that reason to give graph activities a place, since preschool, is very important (Aktaş, 2006).

The number of categories to be compared is, too, as important as the number of object used to form a graph in object graph activities. For example, if the teacher makes his students face a graph about kinds of ice-cream that they like the most, he should primarily pay attention to choose graphs with two categories. This point, too, needs attention for figure chart activities following the activities conducted with object graphs and with two or three categories. Kinds of graphs to be used and number of categories are hierarchical elements that teachers should pay attention about in children's studies of reading and organizing graphs (Baratta-Lorton 1995; cited in Bahr & Garcia, 2010). This hierarchy is shown in terms of kinds and numbers of groups.

Table 1. *Kinds of graphs and number of groups compared*

Kind of graph	Number of groups compared
Object graph	Two categories are compared Three categories are compared
Figure chart	Two categories are compared Three categories are compared
Object graph	Four categories are compared
Figure chart	Four categories are compared
Symbolic graph	Two categories are compared Three categories are compared Four categories are compared

Being more tangible, figure charts could be a proper starting point for introducing graphs to children. Figures, instead of numbers, are shown in graphic representation. It is used to compare the sizes of various categories. Each figure used shows only one parameter or one group. A bar graph is a more concrete form of figure chart because numbers, now, start being used instead of figures. Bar graphs, too, are used for comparison as figure charts are (Olkun & Toluk Uçar, 2004). At the end of a study with 121 fourth grade and 127 sixth grade students on reading twelve different bar graphs, data interpretation, and estimation, Pereira- Mendoza and Mellor (1991) observed that 95 percent of fourth grade students and 98 percent of sixth grade students succeeded in reading data from bar graph.

It is very important, from the perspective of quality education, for teachers to know about the points that children have difficulty and make mistakes in the data teaching. These mistakes could be named as misreading, misunderstanding, carrying out incorrect math operations in translation procedures used for tables and graphs such as doing multiplication instead of addition, making mistakes during operations and misinterpretations in problems related with data (Ryan & Williams, 2007). Koparan and Güven (2013) emphasizes that consistency in statistical thinking, relating, multidimensional thinking and presentation increase towards higher grades in their study in which they aim to define differences between class levels of students of various grades. From that it could be said that statistical thinking is related to cognitive development. On the other hand, it is seen that some sixth grade students show advance thinking in statistical thinking. Therefore, value of experiences students have had in development of statistical thinking skills is supported by the finding of the study. Also, one of the findings of the study is that seventh and eighth grade students could generally read tables, figures, and graphical presentation and recognized pieces of data but that almost half of the sixth grade students generally appeared at the first level. This situation brings it to mind that sixth grade students have had some problems in defining the data. It could be said that a successful data teaching period is possible by designing instructional environment and by instructing teachers who, depending on scientific sources, can develop this period. In primary schools, the foundation of the data analysis and its interpretation stands on the activities that are directed to students' being able to read presentations and being able to be aware of presentations. From this point of view, in the study, it is aimed to describe pre-service elementary teachers' experiences about data teaching process.

Method

This research is a descriptive study that aims to investigate lesson contents about first through fourth grade math lessons prepared by pre-service elementary teachers and experiences they obtained in primary schools they went as a part of teaching practice. Descriptive studies are researches in which obtained data are organized, interpreted, and presented to the readers and in which physical conditions or groups are described (Yıldırım & Şimşek, 2008; Büyüköztürk, Çakmak, Akgün, Karadeniz & Demirel, 2010). Descriptions of pre-service teacher experiences are targeted in the study.

Research Group

Table 2. *Teaching Practice Groups, Practice classes for groups, Sub-learning areas and lesson outcomes for the topic of data*

Pre-service teachers and practice classless	Sub-learning area	Outcomes
1A-1B	Table	The learners will be able to read tables
2A-2B	Object graph	1. The learners will be able to collect data about a problem and form a figure chart. 2. The learners will be able to interpret object graph.
	Table	Learner will be able to organize the data into a table.
3A-3B	Figure chart	1. The learners will be able to collect data about a problem. 2. The learner will be able to create a figure chart. 3. The learner will be able to interpret a figure chart.
	Table	The learners will be able to create tally and frequency tables.
4A-4B-4C	Bar graph	1. The learners will be able to create a bar graph. 2. The learners will be able to interpret a bar graph.
	probability	The learners will be able to use words indicating probability in proper sentences.

Nine fourth-year students attending a state university during the academic year 2013-2014 constitute the research of the study. These students were grouped so that they would practice on data-teaching topic in all classes of the primary schools they went. Pre-service teachers were coded as A, B, and C according to the grade they practiced. These groups, the classes in which groups practiced, sub-learning areas of the topic of data and its outcomes are shown in table 2.

Colectıng Data And Theır Analysıs

Data collecting tools are consisted of semi-structured observation form prepared by the researches and lesson plans prepared by the pre-service teachers.

The observation form about data teaching is composed of four sub-sections. These sections are named as research question and the data (9 items), table (8 items), figure and bar graph (10 items), and supplementary explanations (6 items). The sections have contributed to create themes of the descriptive analysis. The themes have been dealt with under four titles as following and the findings have been presented in the way that each pre-service teachers' actions will be in these themes' coverage.

1) Research question and the data,
2) Table and graph,
3) Supply usage
4) The points at which difficulties have been experienced during the application or that explained incorrectly and incompletely

In the process, pre-service teachers were observed during one-hour-lesson by a researcher, and it is recorded by means of application period observation forms. At the end of the application period, lesson plans prepared by the pre-services teachers were collected from them to analyze. During the data analysis, observed experiences of each pre-service teacher were separately coded according themes defined in the observation form. All documents were analyzed by three researches separately for the reliability of the coding and after all researches reanalyzed the documents for the codes mismatched with each other, a consensus about the coding was reached by the researches. Direct quote were utilized to ensure the external reliability of the study.

Findings

Pre-service teacher: 1/A

Research question and the data. Doing his introduction of the lesson, the pre-service teacher had difficulty and failed to make a proper introduction. He had difficulty in drawing students' attention by saying "I will explain tables. You have already learned it before, so I start right now". He directly asked the research question to the students. Instead of taking answers of the questions, "Do you like colors?" and "What color do you like the most" from the students, he wrote four names of colors on the board and collected students' answers into these categories. Meanwhile, some children did not want to take part by saying "But I don't like these colors". After this activity, he asked, "What animals do you like the most?" and he brought four pıeces of cardboards with anımal pictures on them. Passing out smiley faces to the children, he told them to stick them on to the opposite side of the animal they liked the most.

Table and Graph. After passing out smiley faces to the children, he told them to stick smiley faces on the opposite side of the animal they liked the most. At this stage he encouraged students to collect data, but he drew the table himself. He did not make students do a table-reading study on the table drawn.

Supply usage. He passed out study papers about old Macdonald's farm. The study papers he had chosen had features of ready-made materials. They were photocopied material. The students had difficulty in following the material because they were first graders and because reading-writing activities were still in progress. Study papers were not proper for first graders in terms of spacing and the font used.

The points at which difficulties have been experienced during the application or that explained incorrectly and incompletely. The pre-service teacher had difficulty in keeping class order because the students were at first-grade level. He conducted activities out of the lesson outcomes of the topic of data. The students struggled to understand. In the study paper activity, ready-made materials were used and it was not proper for the level of the class. Creating table activity was chosen instead of table-reading. He had difficulty in keeping the class in order during the activity of table creating because he did not include the students. He himself answered the questions on the study papers and then he asked the students to answer the questions individually. However, the students struggled to answer. It resulted in failure because the students did not know what and where to write. The lecturer of the teaching practice had to warn the pre-service teacher to go more slowly.

Pre-service teacher: 1/B

Research question and the data**.** He made an introduction to the lesson with a question gathered under three categories. He said to the students, "Let's find out who likes honey and milk in this class" and he did not pose it as the research question. He carried on the activity with questions like "Who likes milk? Who likes honey? How many of you like milk?" He did not do an activity like organizing the data and reflecting them to the tables.

Table and Graph. A table activity was presented about seasons. The pre-service teacher showed a table named "students who like seasons" by means of an overhead projector. He asked the students to analyze the table and made an introduction to the lesson by asking, "What season do you like the most? What season are we in now?" Afterwards, he carried on the activity with question like "According the table, what seasons are liked the most, what seasons are liked the least?" He used tables of maximum four categories. In the "my farm" activity, he presented a table with three categories by the overhead projector.

Supply usage. He presented activities as study papers and by overhead projectors. The tables that he used in the table-reading activities were correctly prepared. However, during his instruction on tables, the pre-service teacher carried on activities with routine questions rather than putting forward the relationships between the contexts of the data and tried to squeeze a lot of activity in one lesson. He could not execute the activities on time and the students did not want to take part in table-reading activities.

The points at which difficulties have been experienced during the application or that explained incorrectly and incompletely. Showing the pictures of lions, elephants and horses, he said, "These are animals living in my farm" One of the students said, "Lions and elephants don't live in farms, sir" He presented some table activities like "the most loved colors" and "the most loved animals". He tried to fit all activities in one lesson. After the first 20 minutes, he lost control of the class. The students did not take part in the lesson. He asked proper questions about the tables but the students were lost in the lesson because he did not give any feedback and did not make any relationships between the contexts of the data.

Pre-service teacher: 2/A

Research question and the data**.** He drew a smiley face for each male and female student and asked the number of girls and boys in the class. Asking, "I wonder what fruits are liked the most in this class", he tried to state the fruits liked. Both questions attracted the students' attention. The Children's most loved fruits were gathered under six categories. These are apples, bananas, water melons, coconuts, strawberries and grapefruits. He ignored some preferred fruits. The students asked, "Why weren't ours picked?" The students raised their hands and stated the fruits they liked but he could not determine the number of fruits correctly because there were too many categories. The students did not collect data about the research question given.

Table and Graph. During the determination of the most loved fruits, he did not show the data on the table. He asked the students some questions on the data, which were not recorded. His questions were directed to conducting operations on questions. The questions like "How many of you do you think likes grapefruit and strawberries?" confused the students.

He created a figure chart, not an object graph, about the most loved fruits. He drew a picture of the every fruit that every student liked. The students did not take part in graph creating activities. He asked a few questions like, "What fruit is liked the most? What fruit is liked the least?" on the graph he created. He did not elaborate enough on the interpretation of the graphs.

Supply usage. No materials were used.

The points at which difficulties have been experienced during the application or that explained incorrectly and incompletely. Figure charts were used although object graphs were mentioned for learning outcomes of grades. He did not appoint any duties in collecting data and creating graphs. For that reason, along the lesson, students stayed inactive and he, himself, had difficulty to control the class. He did not do any activity for the lesson outcome: "The learners will be able to organize the data". And, for that reason, the students struggled to make sense of and to organize the data.

Pre-service teacher: 2/B

Research question and the data. He made an introduction to the lesson with the question: "What subject do you like the most?" He himself wrote the names of the lessons without having students' answers. He asked them to name the ones they liked the most among math, social science and turkish. Stating that the students confuse due to many categories, he limited, as a result, the categories to three. Yet some students persistently stated different names of the subjects too. He made a forecast graph for three days for the same reason. The students reacted by saying, "A week has seven days, not three. Why are we doing it like that, sir?"

Table and Graph. The students themselves did not collect the data and did not organize it into the tables. The pre-service teacher first drew the table for the most loved subject and, about the table he drew he asked the questions, "What subjects are the most loved? and What subject are the least liked?" He did not ask any question about the table he drew about the forecast. He wanted the students only to take notes in their notebooks. He never dwelt on concepts of variable and category on the table.

The pre-service teacher brought blue, green, and blue beads. He asked the students to fix the beads with the color they like to the stick they belonged. Some of the students said they did not like these colors and they did not want to fix them to the sticks. Yet, the pre-service teacher stated that they had to choose a color. The students mostly chose blue and there were no more blue beads to fix. Due to being not well-structured, the activity failed. Nevertheless, it was the only activity reflecting the outcomes of the figure charts and allowed the students to do classification.

Supply usage. The beads and the sticks to which beads were fixed were used.

The points at which difficulties have been experienced during the application explained incorrectly and incompletely. The pre-service teacher obliged the students to choose three categories and to study them. He did not give any opportunity for them to collect data and to submit their proposal for research question. He did not allow for the interpretation of the graphs by using directing questions. In the activities with research question given, the students thought they had to determine the categories first because the determination of category activities was done with giving research questions and not giving an opportunity to answer.

Pre-service teacher: 3/A

Research question and the data. The pre-service teacher made an introduction by putting the table he had prepared beforehand the lesson on the board. Instead of making the students notice the research questions the table reflected, he started the lesson by saying, "Let's see what animals are there in old Macdonald's farm". The students did no activity about data collecting.

Table and Graph. The pre-service teacher asked the students, "Who drinks milk every day" and wrote the names of six students on the board. He showed them how to show with the tally method as an example. However, the students had difficulties because reading tally-table activities had not been performed. Correcting the wrong presentation, the pre-service teacher, himself, showed the correct presentations. Some students wanted to correct, but the pre-service teacher did not give them permission to speak. Tally presentations were emphasized, not the tally chart. He affixed some of the animal pictures on the cardboard he had brought. Stating that each picture he had affixed showed three pictures, he asked, "What do you seen on the board?" However, the students struggled to answer because the question was not clear. Later, displacing circles with the animal pictures, he followed a way from the concrete to the abstract. Changing the number of both animals and circles, he asked question like, "How many animals….? What is the most numerous animal? What is the least numerous animal?" and gave some students permission to answer. He called some students to the board and handed them some beads. He said every bead represented five beads and he asked the class to determine how many beads the students at the board had. Two students took part in the lesson and could calculate it, but the rest of the class could not work it out.

Supply usage. A pre-prepared cardboard on which animal pictures were to be stuck with the name of old Macdonald's farm were used as the material.

The points at which difficulties have been experienced during the application explained incorrectly and incompletely. The pre-service teacher asked them to make a bar graph with the beads they had in their hand. Not having created any figure chart well enough and not having seen bar graphs before, the students did not took part in the activity and the teacher dropped the activity. Presenting data on the tables was not elaborated well enough. He tried to cover all four lesson outcomes about tables and graphs in a single lesson. The students participated in the table creating activities by using their pre-knowledge. Activities about the outcomes were not covered completely.

Pre-service teacher: 3/B

Research question and the data. The pre-service teacher asked the questions: "What is tally chart? What is figure chart?" He wanted to check their pre-knowledge but the students had not seen figure charts and tally charts before. They could not answer. He showed the students a zoo and asked them to find out the number of animals. Thus, the students played a role in the process of collecting data. However, it was not stated as the research question.

Table and Graph. Moving from the visuals, the students worked out the number of animals. The pre-service teacher explained what the tally is and gave the students some information about the presentation. He asked the students to write the names of the animals and to show the number of animals next to animal names as tally. The students successfully completed the tally activities. Following the tally chart activities, the pre-service teacher did not ask any question. The students did not name the table they created.

Moving from the table the students created about the zoo, he asked the students to create a figure chart as if the students had known the topic of figure chart. The students did not know what to do. Then the pre-service teacher, personally, drew it on the board. He did not give any information about graphs. When copying the table on the board to their notebooks, most of the students did not write the title of the table, not even record the names of the variables. Showing the figure chart of the liked football teams he prepared and asking questions on the graph, he did some table-reading activities. He proceeded graph reading activities with question like "What football team is the most supported? What football team is the least supported?" Each figure in the graph represented two figures. However, the pre-service teacher forgot to share this with the students.

Supply usage. A zoo picture and a figure chart named "supported football teams" were use as materials.

The points at which difficulties have been experienced during the application explained incorrectly and incompletely. The students behaved as if they did not know figure and tally charts. The pre-service teacher did not dwell on the concept of category. He started figure chart creating activities without conducting any activities like collecting data and creating graphs activities. Because he did not sufficiently emphasize the properties that graphs should bear, the students forgot the details such as naming the created tables and graphs etc. The visual of zoo was not clear. The students counted differently because it was a photocopy.

Pre-service teacher: 4/A

Research question and the data. The pre-service teacher asked, "What comes to our mind when we hear the word graph?" The students replied, "Tally charts, columns, bars, lines, figure charts". The pre-service teacher said "We use tally charts when creating graphs". He passed out candies with three different colors. Without stating the research question, he said, "Let's count the candies in terms of their colors".

Table and Graph. Making the students count the candy in terms of colors, he himself drew a tally chart on the board. Calling a student to the board, he asked to the student to write the number of pieces of candy next to the colors according to the tally graph. Created tables were named. Tally charts and frequency tables were created. The pre-service teacher made an introduction to graph creating activities without conducting any graph reading activities. He asked about the hobbies of the students. He wrote the hobbies of the students under five categories on the board. The pre-service teacher drew a bar graph in both horizontal and perpendicular appearance and asked the students to interpret the data according to the questions he would ask from the graph. He did graph-interpretation activities by asking questions like "How many of you are attending guitar course? What hobby is the most preferred one? What hobby is the least preferred one?"

Supply usage. He did not use any material. From a ready-made source, photocopied study papers were passed out to the students.

The points at which difficulties have been experienced during the application explained incorrectly and incompletely. The pre-service teacher wrote how many students there are in each category opposite to the hobbies in the graph about the hobbies he created. Axis names were not written. The title of the graph was not written either. A histogram was drawn instead of bar graph. Saying, "This is incorrect", he corrected it. One of the students said, "Let's unite the columns, sir". The pre-service teacher replied, "Next time we will do it that way". Copying from the board to their notebooks, the children, too, made histogram-like drawings.

Pre-service teacher: 4/B

Research question and the data. The pre-service teacher asked, "How many of you are attending weekend courses arranged in your school?" The students gave answers; he himself recorded the data and created a table. He asked the students, "On what else subject shall we collect data?" The students replied, "Let it be about games and supported football teams", but the pre-service teacher replied, "No not them, let's collect data about the months you were born in". It is because he had prepared for that. The pre-service teacher had difficulty in determining a research question as an in-class activity.

Table and Graph. Collecting the data, himself, about the children attending weekend courses, he drew the tally chart and the frequency table himself. Afterward, he collected the data about the months the students were born in by asking them to raise their hand. One of the students wanted to draw the table. The student themselves drew the tally chart and the frequency table in accordance with the data. The pre-service teacher asked some question for table-reading. He asked the students, "In what month were the most of your friends born in?" There were four mounts in which the most births took place. One of the students said, "We haven't named the tables". The pre-service teacher named the tables. During table-reading, the students had difficulties because the categories on the table had not been named and because there were too many categories on the tables about the months in which the students were born in. Yet, they correctly answered the questions the pre-service teacher asked. Bar graph activities were not done for those tables.

The pre-service teacher had prepared a bar graph with the name "the most loved colors". He presented it by the help of an overhead projector. He had prepared a graph with four categories. He asked questions like "What is the most loved color? What is the least liked color? How many times bigger is the number of those who like yellow color than the number of those who like black color?" He explained the relationship between lines and columns on the bar graph. The students had difficulty in copying it from the board to their notebooks. They made some incorrect drawings. There were some students who drew bar graphs like a histogram. A table was drawn with the help of the data collected from the students about the football teams supported in the class. One of the students went to the board and drew a bar graph. He correctly set the relation between the columns and the lines. The students sitting in their desks examined what their friends did on the board and copied it in their notebooks. He asked, "What football teams are supported by the most and the least people?" He did not ask anymore questions directed for interpretation. The graphs were drawn horizontally.

Supply usage. He presented the activity named "liked color" by the help of a overhead projector.

The points at which difficulties have been experienced during the application explained incorrectly and incompletely. The pre-service teacher drew a table named Busra's academic success with four categories and he asked the students about the grades that Busra had got from the subjects. Then he said, "I will teach you the mean". He calculated the mean with the grades that Büsra had earned on the subjects. He explained how to work out the mean. He said, "We add the grades up and divide it by four". He told the student to calculate by changing the grades. The students struggled to calculate. He called a student to the board and explained how to work it out step by step. One of the students asked, "What is it for?" He said, "You will learn later".

Pre-service teacher: 4/C

Research question and the data. The pre-service teacher asked the students, "What should be eaten to get some vitamins in cold weathers?" The students replied, "Fruits and vegetables". The pre-service teacher asked "Who likes what fruits". After that, he showed the graph he prepared about the favorite fruits.

Table and Graph. He asked the students, "Who regularly brushes their teeth?" Then he said, "Let's make a table about it". One of the students asked, "Did you ask as days?" The pre-service teacher replied, "Yes". One the students added, "Let it be weekly; it could be difficult to show on the table otherwise". The pre-service teacher said, "Okay". The students told how many times they brush their teeth and the pre-service teacher himself drew the tally chart and the frequency table according to the data. He asked, "Who are those who brush the teeth regularly with respect to the table?" The students could not decide how to answer. The students asked the pre-service teacher, "How will we know if it is done regularly?"

Before the bar graph activity, the pre-service teacher showed the students the figure chart he had prepared about the most loved fruits. He added that each fruit represents three fruits. Then he started graph reading activities. He asked few questions like "What fruit is the most loved and the least liked ones? How many more fruits should banana lovers eat to catch apple lovers?" The per-service teacher took a different number of beads, in five colors, in his hands. He said, "We will draw a bar graph with respect to the number of these beads". He wrote on the board that each bead represents three numbers. The pre-service teacher drew a bar graph considering the number of beads in his hands. He explained how to draw the graph. He asked the students to take some beads in their hands and to draw a bar graph with respect to the number of the beads. The students struggled to align the numbers on the perpendicular axis because the teacher had not explained the relationship between lines and columns in the graph. The pre-service teacher called a student to the board and instructed him to draw the graph. He emphasized only the points at which the student at the board had difficulty in. He did not check the graph of the students who were sitting.

Supply usage. The most loved fruits board prepared by the pre-service teacher was used as the material.

The points at which difficulties have been experienced during the application explained incorrectly and incompletely. Not naming the tables and graphs, the pre-service teacher sometimes forgot to name perpendicular and horizontal axes. Most of the time, the students reminded him. Instead of encouraging the students to create graphs, he asked them to answer the questions for which they can work out in their head on ready-made tables.

Conclusion and Discussion

When analyzing the lessons pre-services teachers prepared and the data about application samples, it could be said that pre-service teachers are not knowledgeable about the topic of data teaching. During the lesson presentations, it was observed that the pre-service teachers struggled, got bored, and asked for help from the class teacher. Pre-services teachers have difficulty in realizing an effective math period with the increase in their level of concern (Swars, Daane, & Giesen, 2006). It has been noticed that especially pre-service teachers who did teaching practice in grade 3 and grade 4 were sometimes criticized and their mistakes were corrected, again, by the students. For example, when one of the students asked, "What is it for?" the teacher coded as 4B could not answer the question and said, "You will learn later". When analyzing the pre-services teacher's practice teaching, one of the attention-drawing points is that it has been observed that the pre-service teachers dealt with outcomes that were outside of the class outcomes. Although the arithmetic mean was not a topic of the grade-four level, the pre-service teacher presented an example about calculating mean and pre-service teacher 4/B, directly giving the rules for the solution of question by saying, "Add up the grades and divide it by four", carried out the solution of the problem.

It was seen that pre-service teachers are not completely knowledgeable about the concepts of category and variable in table and graph activities. In some examples, too many categories, over the class level, for the variable were determined and for that reason the students had difficulty in organizing the data. Again, the pre-service teachers did not name the tables, graphs and the axes in the table and graph activities. Some pre-service teachers, either, did not ask about the students' ideas in the activities of category determination and so, the students showed reluctance for taking part in the activities. Sometimes, the students warned the pre-service teacher or told the activities that could be done and the pre-services teachers did activities in the same direction accordingly. For example a pre-service teacher who, using too many categories, struggled shared his experiences with another pre-service teacher named 2/B and 2/B limited the number of categories in the activities. Teaching practice opportunities for pre-service teachers becomes more effective with their natural sharing experiences in teacher-student and teacher-teacher interactions. The pre-services teachers' positive opinions that they can effectively teach the topics in the first grade level show that experiences acquired in real class contexts have very important effect on their pedagogical development.

At the stages of collecting and organizing the data, it was observed that pre-service teachers themselves did the works in the class instead of instructing the students to do. Posing the research question to the class, after collecting the data of the class about the research question from the students, some pre-service teachers organized the data either by themselves or with one or more students. The students who were sitting at their desks took part in the lesson by observing and copying what was done on the board made mistakes. It is thought that pre-service teachers see themselves, not the students, at the center and for that reason they could not do a lesson in accordance with constructivist approach. When the number of teaching practice and their duration increase, it could be said that pre-service teachers will realize lessons in which student are more active and that the way they do their teaching practice will change. In the lessons that elementary teachers will do about the topic of data, they should try to take care to:

a) Use real data;

b) Present good examples about the topic of data;

c) Ensure that students are active in all stages in the topic of data (Franklin et al., 2007).

During a single lesson more than one table and graph activities were done and, as a result, the lesson outcomes that wanted to be acquired was overlooked. It was seen that pre-service teachers did not well enough emphasize table and graph reading activities. Defining the data is something beyond roughly-reading the information exists on the tables and graphs. Reading the data is to see the information on the data representation without having any difficulty, to understand the given graph, and to make sense of the data in its context (Curcio, 1987). Koparan and Guven (2013) highlighted that since activities which are directed to primary school students' being able to be aware of the data presentations and being able to read some certain data from data presentation will set the foundation for the analysis and the interpretation of the data, these activities need to be done. For example, during table activities, activities in which one figure represented a few figure were carried out in the class but the pre-service teachers did not dwell on these activities in both table and graph activities. In table-reading, and table and graph interpretation activities, they rather preferred to instruct the student to study with questions directed to making operations instead of questions that would direct the students to interpret. In the conversations with the pre-service teachers after the teaching practice lessons, the pre-service teachers stated that they did not know what to ask, that there were exercise questions in the sources as routine so they mostly preferred to use these kinds of questions and that they became quite anxious.

In the lessons, the pre-service teachers used the overhead projector, study papers, ready-made cardboards for presentations, and the board as materials. Especially in collecting data and object graph activities, real objects, too, like beads, sticks, and candies are among the examples of material usage. Pre-service teachers did not do any activity in the computer environment although there were computers in the classes they did teaching practice.

It has drawn attention that in figure chart activities in the second-grade level, the pre-service teachers perceived figure charts as object graphs. Doing figure chart activities instead of object graph activities, the pre-service teacher 2/A did not include the students in the data collecting process and carried out the lesson with ready-made activities. 2/B brought blue, green, and red beads and wanted the students to fix the beads with the color they like to the sticks. Saying,"Are there only these colors? I don't like these colors", some students said they did not want to fix the beads, but the pre-service teacher said they had to choose a color. Nevertheless, the activity worked out successfully because a natural figure chart activity was realized and the students were active in the activity. Without having done figure chart activity well enough, the pre-service teacher 3/A attempted to do a bar graph activity in, again, grade 3 level but the students had difficulty in placing the number in sequence on the perpendicular axis and in naming the axes in the activity. One of the hardships experienced in the graph activities was encountered in bar graph activities in grade 4 level. Difficulties were experienced in graph creating activities because of not having adequately done bar graph activities and because of the conducted activities in which teachers were active while the students passive. For example, copying already-drawn bar graphs on the board to their notebooks, those who made drawings similar to histograms drew attention. Meanwhile, it was seen that the pre-service-teachers did not have any information about the differences between bar graphs and histograms. For example, in bar graph activities, the pre-service teacher named as 4/A drew horizontal and perpendicular axes and created the graph according the data given. However, names of the axes and title of the graph were not written either. He drew a histogram for a bar graph and later corrected it by saying, "This wouldn't do". One of the students said, "Let's unite the columns" but the pre-service teacher replied, "In the next one, we will do it". Copying from the board to their notebook, the children, too, made some drawings similar to histograms. That the pre-services teachers did not know about the differences between bar graphs and histograms caused the students to incorrectly learn and to make incorrect drawings. Bar graphs and histograms are very similar in appearance. Columns are used to show frequencies belonging to the categories in both kinds of graph. The difference between bar graphs and histograms is the kind of data being used. If the numbers representing categories are continuous, or if the numbers are able to be regrouped in different intervals, histograms can be used. If the data are non-continues, bar graphs can be used (Musser, Burger & Peterson, 2008). That pre-service teachers know basic concepts in the topic of data is important from the point of view that they should be able to prevent students from incorrectly learning.

Completing the process with favorable and useful experiences, very few pre-service teachers who worked with a lecturer and a teaching practice teacher who was enthusiastic, eager, and conscious of his duties mentioned the experiences they had in the real learning environment and about the feeling that they felt themselves like a real teacher (Eraslan, 2008). In this study, too, in the assessment study that pre-service teachers did with the teaching practice teachers after the lesson, they stated that they remembered the explanations done in the scope of "Math Teaching" course and that, preparing to teach the students the topic of data in the practice school, they revised what they learnt in the lessons but they struggled, failed to put their knowledge into application, and, made mistakes during the lesson in the class environment. The pre-service teachers expressed that they benefitted from the activities about the topic of data along the teaching practice process and from the assessments done after the lessons. Moving from these results, it could be said that "math teaching" course has an important place in pre-service teachers' pedagogical development and that, for that reason, the lecturers should show sensitivity in the execution of the lesson.

In the education of elementary teachers who will set the foundation for math topics and concepts, the importance of "math teaching" course and the lecturer executing the lesson are obviously seen. Pre-service teachers' practice teaching processes should be analyzed in not only the topic of data but also other math topics too, and the results, meeting the deficiencies, should be shared with pre-service teachers.

● ● ●

References

Aktaş, Y. (2006). *Okul Öncesi Dönemde Matematik Eğitimi* (3. Baskı). Adana: Nobel Kitabevi.

Bahr, D. L., & De Garcia, L. A. (2010). *Elementary mathematics is anything but elementary*.Belmont: Wadsworth, Cengage Learning.

Biggs, J. B., & Collis, K. F. (1991). Multimodal Learning and Intelligent Behavior. In H. Rowe (Eds.), *Intelligence: Reconceptualization and Measurement* (pp. 57-76). Hillsdale, NJ: Erlbaum.

Büyüköztürk, Ş., Kılıç Çakmak, E., Akgün, E. A., Karadeniz, Ş., ve Demirel, F.(2010). *Bilimsel Araştırma Yöntemleri.* Ankara: Pegem Akademi.

Cathart W. G., Pothier Y. M., Vance J. H., & Bezuk N. S. (2006). *Learning Mathematics in Elementary and Middle Schools: A Learner - Centered Approach* (Fourth Edition). USA: Pearson Education.

Carruthers, E., & Worthington, M. (2006). *Children's Mathematics, Making Marks, Making Meaning* (Second Edition). London: Sage Publications.

Charlesworth, R. (2000). *Experiences in Math for Young Children.* Delmar: Thompson Learning.

Curcio, F. R. (1987). Comprehension Of Mathematical Relationships Expressed in Graphs. *JournalFor Research İn Mathematics Education, 18*, 382-393.

Eraslan, A. (2008). Fakülte-Okul İşbirliği Programı: Matematik Öğretmeni Adaylarının Okul Uygulama Dersi Üzerine Görüşleri. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi 34*, 95-105.

Franklin, C., Kader, G., Mewborn, D. S., Moreno, J., Peck, R., Perry, M.& Scheaffer, R. (2007). Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report: A Pre-K-12 curriculum framework. American Statistical Association.

Franklin C. A.& Denise S. M. (2008). "Contemporary Curriculum Issues: Statistics in the Elementary Grades: Exploring Distributions of Data." Teaching Children Mathematics. (14), 10–16.

Friel, S. N., Curcio, F. R. , & Bright, G. W. (2001). Making Sense of Graphs: Critical Factors Influencing Comprehension and Instructional Implications. *Journal for Research in Mathematics Education. 32*(2), 124–158.

Hacıömeroğlu, G. (2012). Pedagojik Gelişim Ölçeğinin Türkçe'ye Uyarlaması: Sınıf Öğretmeni Adaylarının Matematik Öğretimine İlişkin Gelişim Düzeyi. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi,18,* 48-68.

Jones, G. J., Thornton, C. A., Langrall, C. W, Mooney, E. S, Perry, B., & Putt, I. J. (2000). A Framework for Characterizing Children's Statistical Thinking. *Mathematical Thinking and Learning, 2*(4), 269–307.

Koparan, T. ve Güven, B. (2013). İlköğretim İkinci Kademe Öğrencilerinin İstatistiksel Düşünme Seviyelerindeki Farklılaşma Üzerine Bir Araştırma. *İlköğretim Online, 12*(1), 158-178.

Matematik Dersi (1-5. Sınıflar) Öğretim Programı (2009). 11.02.2015. Retrieved from http://ttkb.meb.gov.tr/www/ogretim-programlari/icerik/72

Musser, G. L, Burger, W. F., & Peterson, B. E. (2008). *Mathematics For ElementaryTeachers: A Conteporary Approach* (Eighth Edition). USA: John Wiley&Sons.

Olkun, S., ve Toluk Uçar, Z. (2004). *İlköğretim Etkinlik Temelli Matematik Öğretimi* (3.baskı). Ankara: Anı Yayıncılık.

Pereira-Mendoza, L., & Mellor, J. (1991). Students' concepts of bar graphs: Some preliminary findings. In D. Vere-Jones (Ed.), *Proceedings of the Third International Conference on Teaching Statistics: Vol. 1* (pp. 150-157). The Netherlands: International Statistical Institute.

Ryan J. and Williams J. (2007). Children's Mathematics 4-15:Learnıng From Errors And Mısconceptıons. (First published). Berkshire England: Open University Press

Swars, S. L., Daane, C. J., & Giesen, J. (2006). Mathematics Anxiety and Mathematics Teacher Efficacy: What is the Relationship in Elementary Preservice Teachers? *School Science and Mathematics*, *106*(7), 306–315.

Van de Walle, J., Karp, K. S., Bay-Williams, J. M. (2010). Elementary and middle school

mathematics; Teaching developmentally, (7th ed.).Boston, MA: Allyn ve Bacon

Yıldırım, A., ve Şimşek, H. (2008). *Sosyal Bilimlerde Nitel Araştırma Yöntemleri*. Seçkin Yayıncılık.

International Electronic Journal of Elementary Education, 2015, 7(3), 371-382.

Preschool Children's Perceptions of the Value of Affection As Seen in Their Drawings

Yunus GÜNİNDİ *

Aksaray University, Turkey

Received: 3 January 2015 / Revised: 15 March 2015 / Accepted: 27 April 2015

Abstract

The purpose of this study is to examine the perceptions of children in preschool education with regard to the value of affection in the pictures they draw. The study involved 199 children aged 60 months old or above. The descriptive research method was used and data were collected with the draw-and-explain technique. During the collection of the data, the children were requested to draw a picture related to the value of affection and explain the picture they drew. The children's explanations were recorded by the researcher. The study is one of the first to be conducted in Turkey with preschoolers in this research area. The results showed that the children generally depicted human figures like family members, other children and friends, animals like butterflies and dogs, trees, flowers and grass, happy images such as hearts, balloons and balls, and abiotic images like clouds and sunshine, as well as other images like houses in their drawings. The children tended especially to feature people and objects in their immediate vicinity.

Keywords: Preschool, drawing of value of affection, value education, perception of value of affection in children.

Introduction

From birth, humans find themselves within a social existence and try to adapt themselves to their socio-cultural environment. This effort of adaptation continues throughout the child's development. The basis of children's social and emotional development is substantially built in the first years of life, as with all areas of development (Günindi, 2011). Therefore, early childhood constitutes the most critical part of life in terms of adopting values that children will need socially. Because children in this period are going through the fastest stage of their development, where their personality is built, they are strongly affected by their immediate environment and open to any kind of learning. Their development can therefore be supported with timely and efficient interventions.

Between the ages of zero and six a child begins to adopt the value judgments of the immediate society and the behaviors and habits that comply with its cultural texture. The

* Yunus Günindi, Aksaray University, Adana Yolu Uzeri Campus, Aksaray, 68100, Turkey, Phone: +90 (382) 288-2271. E-mail: yunusgunindi@aksaray.edu.tr

ISSN:1307-9298

child's interaction with his/her peers and other individuals within the environment during the preschool period helps them gain many positive and negative behaviors, skills, manners and opinions. These build the basis of their value judgments. While information about values is learnt during a person's whole life, the first knowledge is gained in early childhood (Bilir & Bal, 1989; Bronson, 2000; Davies, 2004; Uyanık-Balat & Balaban-Dağal, 2009; Dereli-İman, 2014).

Many definitions have been proposed for the notion of 'value'. Although it is generally defined as an important criterion within cultures and societies, values tend to be understood to consist of objectives generated against the backdrop of the ideas, standards and targets adopted by a group, or behavioral patterns organized such that the individual can maintain his/her existence within the group in accordance with the standards that are considered right by all the individuals within the society. Values can also correspond to behaviors and implementations which grow over a long period and to which society expects individuals to conform, or generalized ethical principles or beliefs which are considered right and useful by most of the members of a social group or society in order to maintain the existence, unity and continuity of that group or society; they can also reflect common feelings, opinions, targets and benefits, or more or less certain and systematic ideas enabling the individual's interaction with the environment (Türk, 2009; Fichter, 2006; Bolay, 2004; Veugelers & Vedder, 2003; Kızılçelik & Erjem, 1996; Titus, 1994).

Studies conducted on values education in Turkey and the world generally focus on topics like the provision of values, implementing values education programs, and the effect of the family on values education. Children's own opinions of values and the way they perceive and make sense of them seem not to have been studied adequately. Existing studies involving interviews and surveys among teachers or families have tended not to favor drawing as a means to determine children's perceptions (Revell, 2002; Veugelers & Kat, 2003; Berkowitz & Bier, 2005; Skaggs & Bodenhorn, 2006; Gökçek, 2007; Husu & Tirri, 2007; İnci, 2009; Richardson, Tolson, Huang & Lee, 2009; Üner, 2011; Öztürk Samur, 2011; Uyanık Balat, Özdemir Beceren & Adak Özdemir, 2011). However, pictures provide the potential for children to present their world-views in their reactions against telling a story, relaying metaphors and both the description itself and their own descriptions. A child synthesizes his/her opinions and feelings about the subject with his/her observations and expresses them by means of colors, shapes and lines while drawing (Malchiodi, 2013). Children synthesize their observations from life with their opinions in their pictures, and reflect on what happens in their environment in the way they perceive it. Drawing a picture is both an enjoyable activity and an explanation technique for children (Hayes, Symington & Martin, 1994; Johnson, 1993). While children are often uncomfortable answering questions asked in interviews, they express the same information willingly when asked to draw a picture (Lewis & Greene, 1983). Drawing is also seen as an alternative means of expression for children who cannot express themselves verbally (Chambers, 1983; Rennie & Jarvis, 1995). If pictures drawn by children are analyzed well, they can provide researchers with detailed information about their knowledge and development (Yavuzer, 1997), perhaps more so than written or verbal texts.

Aspects of psychology have been lighting the way in the field of psychiatry and picture therapy (Malchiodi, 2013). The objects drawn by children, colors and the painting materials they use can all provide important clues for diagnostic and therapeutic purposes. Diagnosis and treatment are not included in this study, so these elements have not been evaluated in the children's drawings. This research was conducted with the draw-and-explain technique to determine the perception of children in relation to the value of 'affection'. The literature review revealed no studies analyzing the drawings of children in relation to the value of 'affection'. This study therefore fills a research gap.

Method

The descriptive research method was used and data were collected with the draw-and-explain technique. The study group consisted of 199 children in total, who went to independent kindergartens in Aksaray and were aged 60 months or above.

Measurement Tool

The draw-and-explain technique was used to determine the children's perception of the value of 'affection' (Brackett-Milburn, 1999; Shepardson, 2005). This technique observes children's drawings and their explanations of these drawings. The draw-and-explain technique is a diagnostic method used to evaluate how children structure opinions and concepts (McWhirter, Collins, Bryant, Wetton & Bishop, 2000). The children were asked to draw whatever came to their minds when 'affection' was mentioned, and to explain these drawings. The researcher recorded the children's explanations according to pre-prepared codes applied to each drawing

Application Process and Environment

The study was conducted within the academic year 2014–2015. After permission had been obtained, the researcher went to the participating institutions and informed the administrators about the study. After this information had been obtained, an implementation plan was drawn up together with the school managers to determine when and how the assessment instrument would be applied. While the children narrated their drawings, the narration was recorded.

Researcher's role: Before the research, the researcher visited the participating schools for three weeks to teach two-hour lessons about issues independent of the research (children were asked to draw responses to such questions as 'What comes to your mind when you hear "environment"?', 'What does "hero" mean for you?", 'What does 'being healthy' mean for you?', and so on). This was to enable the children to get used to the researcher so they could express themselves comfortably.

Finally, the researcher asked the children "What comes to your mind when you hear 'affection'?" and they were asked to draw their responses. The children's responses were not guided or interrupted by the researcher. After the children had completed their drawings, the researcher asked about them and what they wanted to express. Each drawing was filed separately after the researcher had recorded each child's narration of his or her drawing on a blank sheet and attached it to the reverse of each picture.

Data analysis

The data obtained were analyzed using interpretative content analysis, a qualitative method (Ball & Smith, 1992; Banks, 2001). The interpretative content analysis included determination and definition of themes, subjects and cases in the visual and written material obtained from the study (Giarelli & Tulman, 2003).

The codes and themes acquired were reviewed by the researcher for validity and reliability and analyzed using the same procedures as different specialist researchers. The reliability formula suggested by Miles and Huberman (1994) was used to calculate the reliability of the research: Reliability = Agreement / (Agreement + Disagreement)

The research reliability was calculated as 92%. Values above 70% are considered reliable (Miles & Huberman, 1994), so this research can be considered reliable. In addition, to evaluate the consensus between the experts and the researcher a Kappa (conformity) analysis was carried out. At the end of this assessment the Kappa value was found to be 86%. The results can therefore be considered reliable.

The use of verification strategies in qualitative research is important to increase reliability (Morse et al., 2002). Thus, all steps followed in the research are reported. The researcher made relevant notes about the application environment and implementation process in the form of short notes. Notes not used as data enabled the researcher to review the implementation. The data obtained from the study were also reported in the context of a descriptive analysis and a percentage and frequency analysis.

Findings

In total, 10 categories and 104 codes were obtained from the analysis of the data. Children generally drew human figures like family members, other children and friends, animals such as butterflies and dogs, trees, flowers and grass, happy images such as hearts, balloon and balls, abiotic images like clouds and sunshine, and structures like houses.

Table 1. *Figures included in the drawings of the children participating in the study*

Categories	Codes	60 months old or above	
		f	%
Family/Relatives	Mother	56	28.1
	Father	46	23.1
	Siblings	57	28.6
	Themselves	35	17.6
	Grandmother	2	1
	Paternal grandmother	3	1.5
	Grandfather	16	8
	Uncle	4	2
	Maternal aunt	2	1
	Brother’s wife	3	1.5
Other People	Friends	15	7.5
	Baby	4	2
	Child	34	17.1
	Visitor	10	5
	Teacher	9	4.5
	Greengrocer	3	1.5
Plants	Tree	22	11.1
	Flower	68	34.2
	Grass	24	12.1
	Fruit	13	6.5
Animals	Bird	2	1
	Butterfly	38	19.1
	Dog	11	5.5
	Cat	8	4
	Bear	2	1
	Rabbit	5	2.5
	Sheep	2	1
	Turtle	3	1.5
	Shark	1	.5
	Fish	4	2
	Chick	10	5

Table 1 (Cont.). *Figures included in the drawings of the children participating in the study*

Categories	Codes	60 months old or above	
		f	%
Animals	Ant	4	2
Abiotic Elements	Mountain	4	2
	Cloud	42	21.1
	Sun	84	42.2
	River	5	2.5
	Sea	5	2.5
	Planet	2	1
	Sky	7	3.8
	Beach	2	1
	Star	4	2
Buildings/Vehicles	Home	65	32.7
	School	6	3
	Car	13	6.5
	Plane	1	.5
	Road	6	3
	Farmstead	5	2.5
	Elevator	2	1
	Bicycle	1	.5
	Wall	3	1.5
	Pool	1	.5
	Statue	3	1.5
	Bulldozer	2	1
	Traffic lamp	4	2
	Ladder	5	2.5
	Motorcycle	2	1
	Semi	2	1
	Rocket	2	1
	Slide	3	1.5
	Rail	3	1.5
Happy image	Balloon	6	3
	Entertainment	1	.5
	Smile	3	1.5
	Gift	2	1
	Heart	40	20.1
	Kiss	1	.5
	Cotton candy	2	1
	Money	2	1
	Affection	2	1
	Ball	7	3.5
	Kite	2	1
	Ankara	2	1
	Istanbul	2	1
	Play	3	1.5
	Toy	3	1.5
Foods	Pastry	2	1
	Potato	3	1.5
	Nuts	3	1.5
	Egg	3	1.5

Table 1 (Cont.). *Figures included in the drawings of the children participating in the study*

Categories	Codes	60 months old or above	
		f	%
Natural Events/ Seasons	Rainbow	15	7.5
	Rain	2	1
	Snow	2	1
	Winter	8	4
	Summer	3	1.5
Others	Computer	3	1.5
	Paint	2	1
	Dress	2	1
	Bag	2	1
	Nail	1	.5
	Closet	4	2
	Ghost	1	.5
	Rope	1	.5
	Cage	1	.5
	Door	2	1
	Book	2	1
	Window	4	2
	Straw	2	1
	Chair	2	1
	Number	2	1
	Wheel	1	.5
	Television	2	1
	Vase	2	1
	Leaf	1	.5
	Snowman	6	3

The images included in the drawings and the frequencies of these images are given in Table 1. 42.2% of the children who participated in the study depicted sunshine, 34.2% flower(s), 32.7% house(s), 28.6% sibling(s), 28.1% their mother, 23.1% their father, 21.1 cloud(s), 17.6% themselves and 17.1% other children in their drawings. The most-encountered animal in the pictures was the butterfly (19.1%), followed by the dog (5.5%) and the rabbit (2.5%). Images that expressed happiness such as hearts (20.1%), balls (3.5%) and balloons (3%) were also observed.

Examples of children's drawings are given in Picture 1, Picture 2, Picture 3 and Picture 4.

Picture 1 drawing, the child shows an unknown girl, herself, a flower, grass and a cloud. The child narrates her drawing as follows: "I am gifting a flower to a girl whom I don't know. The girl to whom I gift the flower gets very happy and walks on air. Then, she starts running, saying that she has to go. She falls down, because she stumbles while running. I help her with getting up. She thanks me. The fact that I give a flower to someone whom I don't know, and help her, shows my affection for her, and it points at her affection for me when she thanks me."

Smiling children and flowers, grass and blue clouds are also observed in the pictures of many other children.

In Picture 1, the value of 'affection' was described with the figures of an unknown girl, herself, flower, grass and cloud. Picture 2 shows happy-looking people including the child's mother, father and sibling, at home in sunny weather. A heart has also been drawn to intensify the impression of 'affection'.

Picture 1.

Picture 2.

Picture 3.

In this drawing, a flower, a house, sunshine, a butterfly, a rabbit, a child, and some grass and clouds are shown. The child narrated the picture by saying: 'Affection means loving nature, flowers and animals.'

In the picture, the sun, flowers and smiling rabbit and butterfly stand out.

Picture 4.

In Picture 3, the value of 'affection' was described with flower, house, sun, butterfly, rabbit, child, grass and cloud figures. Picture 4 depicts a friend, sunshine, a butterfly, some flowers, some stairs and a heart. The child narrated his/her picture by saying: 'Affection means loving your friend, mother, father, everyone and nature." We can see that the heart image was used to intensify the impression of 'affection'.

When the records of the interviews held with children are reviewed, we can see that being with family members, other people and plants and animals has particular significance within children's perceptions of the value of 'affection'.

Discussion and Suggestions

'Affection' is described as "the feeling that directs a person to show close interest and attachment to a thing or a person" by the Antalya Governorship Provincial Directorate of National Education, in the booklet entitled 'Values Education in Preschool'. In line with the Ministry of National Education, the booklet mentions the necessity of helping preschoolers adopt affection for nature, animals and plants (M.N.E., 2011). The participating children spoke about their drawings by making stories out of them. Some of their narrations were as follows:

Child A: Affection means hugging my mum and dad.

Child B: Affection means things in nature loving each other.

Child C: Affection means my mum, my dad and my siblings. It means flying birds in the sky.

Child D: Affection means loving nature. Affection means growing flowers and loving animals.

Child E: Affection means sun's chatting with sun's friend, rabbit's having a chat with rabbit's friend, people loving both nature and animals.

The interviews held with children show affection for family members, relatives, friends and even people they do not know, besides affection for nature, animals and plants.

As stated, the literature review revealed no studies using the draw-explain technique with regard to the value of 'affection' for preschoolers. Moreover, few studies were encountered involving preschoolers within the scope of values education; such studies that existed mostly involved children in primary and secondary schools, families or teachers. These studies examined the relationship between behavior and success and between the values education program and family participation, ethical maturity, and academic success, differences in value preferences between male and female students, the effect of values education on the exhibition of positive behaviors and level of social-emotional development, the values expected of children by families, and the effect of teachers relaying values as a result of the program applied for values education, using assessment instruments such as surveys and interviews (Dilmaç, 1999; Veugelers & Kat, 2003; Sarı, 2005; Berkowitz & Bier, 2005; Skaggs & Bodenhorn, 2006; Gökçek, 2007; Husu & Tirri, 2007; Katılmış, 2010; Öztürk Samur, 2011; Uyanık Balat, Özdemir Beceren & Adak Özdemir, 2011).

Pictures drawn by children can be used to determine their knowledge about a topic, their misconceptions and interests. The first researchers to study children's pictures did so to determine their intelligence level (Burt, 1921; Goodenough, 1926; Harris, 1963). Some early theorists and researchers also examined children's pictures in relation to developmental and personality traits within the process (Koppitz, 1968; Hammer, 1958;

Machover, 1949). Studies conducted on children's pictures and on how children perceive what happens in their environment have started to be used by educators in recent years. Although the examination of children's drawings is an effective method, the number of studies conducted on this topic is quite low. On this basis, drawings should be used also for different values in future studies within the scope of values education. Pictures drawn by children can also be used to assess children's opinions and perceptions, the causes of values-related problems they encounter in the school and family environment, and the solutions they think of to solve these problems. Although a limited number of children were studied in relation to 'affection' in this study, the data obtained are valuable because to the researcher's knowledge there are no existing studies on children's perception of the value of 'affection' using their drawings. In the future similar studies should be carried out with different samples and the results compared. Even though the self-expression of children by drawing is an effective subject for analysis, it has some limitations. Interviews should be carried out with children and recorded, besides having them draw pictures in order to reduce limitations.

• • •

References

Ball, M. & Smith, G. (1992). *Analyzing and visualizing data*. London: Sage.

Banks, M. (2001). *Visual methods in social research.* London: Sage.

Berkowitz, M. W. & Bier, M. C. (2005). Character education: parents as partners. *Educational Leadership,* 63(1), 64-69.

Bilir, Ş. & Bal, S. (1989). Kütahya il merkezinde anaokuluna giden ve gitmeyen 4-6 yaşlar arasındaki çocukların kullandıkları ifadelerin sözdizimi yönünden incelenmesi: *6.Ya-Pa Semineri Kitapçığı*. İstanbul: Ya-Pa Yayınevi.

Bolay, S. H. (2004). Değerlerimiz ve günlük hayat. *Değerler Eğitimi Merkezi Dergisi*, 1(1), 12-19.

Brackett-Milburn, K. (1999). A critical appraisal of the draw and write technique. *Health Education Research,* 14(3), 387-395.

Bronson, M. B. (2000). *Self-regulation in early childhood: Nature and nurture*. New York: Guildford Press.

Chambers, D. W. (1983). Stereotypic images of scientists: The draw-a-scientist test. *Science Education,* 67(2), 255-265.

Davies, D. (2004). *Child development a practitioner's guide*. New York: Guildford Press.

Dereli-İman, E. (2014). Değerler eğitimi programinin 5-6 yaş çocuklarin sosyal gelişimine etkisi: sosyal beceri, psiko-sosyal gelişim ve sosyal problem çözme becerisi. *Kuram ve Uygulamada Eğitim Bilimleri*, 14 (1), 249-268.

Dilmaç, B. (1999). *İlköğretim öğrencilerine insani değerler eğitimi verilmesi ve ahlaki olgunluk ölçeği ile eğitimin sınanması*. Yayımlanmamış Yüksek Lisans Tezi. İstanbul: Marmara Üniversitesi Eğitim Bilimleri Enstitüsü.

Fichter, J. (2006). *Sosyoloji nedir* (Çev. Nilgün Çelebi). Ankara: Anı Yayıncılık.

Giarelli, E. & Tulman, L. (2003). Methodological issues in the use of cartoons as data. *Qualitative Health Research,* 13(7), 945-956.

Gökçek, B. S. (2007). *5–6 yaş çocukları için hazırlanan karakter eğitimi programının etkisinin incelenmesi.* Yayınlanmamış Doktora Tezi. Marmara üniversitesi Eğitim Bilimleri Enstitüsü İlköğretim Ana Bilim Dalı Okul Öncesi Eğitimi Bilim Dalı, İstanbul.

Günindi, Y. (2011). Bağımsız anaokullarina ve anasiniflarina devam eden çocuklarin sosyal becerilerinin değerlendirilmesi. *Ahi Evran Üniversitesi Eğitim Fakültesi Dergisi*, Cilt 12, Sayı 1, Nisan 2011, Sayfa 133-144.

Hayes, D., Symington, D., & Martin, M. (1994). Drawing during science activity in the primary school. *International Journal of Science Education,* 16, 265-277.

Husu, J. & Tirri, K. (2007). Developing whole school pedagogical values – a case of going through the ethos of good schooling. *Teaching and Teacher Education*, 23(4), 390-401.

İnci, E. (2009). *Erken çocukluk dönemi öğrencilerinin değer yönelimlerinin sosyo-ekonomik düzey, yaş ve cinsiyet değişkenlerine göre incelenmesi*. Adnan Menderes Üniversitesi, Sosyal Bilimler Enstitüsü, İlköğretim Anabilim Dalı Yayınlanmamış Yüksek Lisans Tezi. Aydın.

Johnson, P. (1993). *Literacy through the book arts.* Chicago: Heinemann.

Katılmış, A. (2010). *Sosyal bilgiler derslerindeki bazı değerlerin kazandırılmasına yönelik bir karakter eğitimi programı geliştirilmesi.* Yayınlanmamış Doktora Tezi. Marmara Üniversitesi Eğitim Bilimleri Enstitüsü, İstanbul.

Kızılçelik, S. & Erjem, Y. (1996). *Açıklamalı sosyoloji terimler sözlüğü*. İzmir: Saray Yayıncılık.

Lewis, D. & Greene, J. (1983). *Your child's drawings… their hidden meaning,* London: Hutchinson.

Malchiodi, A. C. (2013). *Çocukların resimlerini anlamak* (Çev: Yurtbay, T.). Nobel Tıp Kitapevleri, İstanbul.

McWhirter, J. M., Collins, M., Bryant, I., Wetton, N. M., & Bishop, J. N. (2000). Evaluating 'safe in the sun', a curriculum programme for primary schools. *Health Education Research*, 15(2), 203-217.

M.N.E. (2011). *Values Education in Preschool'.* Antalya Governorship Provincial Directorate of National Education, 2011.

Miles, M. B. & Huberman A. M. (1994). *Qualitative data analysis: an expanded source book*. Thousand Oaks, CA: Sage.

Morse, J.M., M. Barrett, M. Mayan, K. Olson, & J. Spiers. (2002). Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods*, 1(2), 13-22.

Öztürk, S. A. (2011). *Ayrıntılı değerler eğitimi programının 6 Yaş çocuklarının sosyal ve duygusal gelişimine etkisi*. Yayımlanmamış Doktora Tezi. Selçuk Üniversitesi Sosyal Bilimler Enstitüsü, Konya.

Rennie, L. J. & Jarvis, T. (1995). Children's choice of drawings to communicate their ideas about technology. *Research in Science Education*, 25(3), 239-252.

Revell, L. (2002). Childrens responses to character education. *Educational Studies*, 28(4), 421-431.

Richardson, R. C., Tolson, H., Huang, T. Y. & Lee Y. H. (2009). Character education: lessons for teaching social and emotional competence. *Children & Schools*, 31(2), 71-78.

Sarı, E. (2005). Öğretmen adaylarının değer tercihleri: giresun eğitim fakültesi örneği. *Değerler Eğitimi Dergisi*, 3(10), 73-88.

Shepardson, D. P. (2005). Student's ideas: what is an environment? *Journal of Environmental Education,* 36(4), 49-58.

Skaggs, G. & Bodenhorn, N. (2006). Relationships between implementing cracter education, student behavior and student achievement. *Journal of Advanced Academics*, 18, 1, 82-114.

Titus, D. N. (1994). *Value education in American secondary schools.* Paper presented at the Kutztown University Education Conference. Kutztown, PA, September 16.

Türk, İ. (2009). *Değerler eğitiminde saygı*. Yayınlanmamış Yüksek Lisans Tezi, Gaziosmanpaşa Üniversitesi Sosyal Bilimler Enstitüsü, Tokat.

Uyanık-Balat, G. & Balaban-Dağal, A. (2009). *Okul öncesi dönemde değer eğitimi etkinlikleri*. Ankara: Kök Yayıncılık.

Uyanık-Balat, G., Özdemir-Beceren, B. & Adak-Özdemir, A. (2011). The evaluation of parents' views related to helping pre-school children gain some universal values. *Procedia - Social and Behavioral Sciences*, 15, 908-912.

Üner, E. (2011). *Okul öncesi eğitim programındaki 36-72 aylık çocuklara farklılıklara saygı eğitimi kazandırmanın öğretmen görüşleri doğrultusunda değerlendirilmesi.* Yayınlanmamış Yüksek Lisans Tezi, Erciyes üniversitesi Eğitim Bilimleri Enstitüsü. Kayseri.

Veugelers, W. & Vedder P. (2003). Values in teaching. teachers and teaching: *Theory and Practice*, 9(4), 377-389.

Veugelers, W. & Kat, E. (2003). Moral task of the teacher according to students, parents and teachers. *Educational Research and Evaluation*, 9(1), 75-91.

Yavuzer, H. (1997). *Resimleriyle çocuğu tanıma.* İstanbul: Remzi Kitapevi.

International Electronic Journal of Elementary Education, 2015, 7(3), 383-398.

ISMS: A New Model for Improving Student Motivation and Self-esteem in Primary Education

Yaron GHILAY *

The Neri Bloomfield Centre of Design and Education, Israel

Ruth GHILAY

Byalik School, Israel

Received: 1 December 2014 / Revised: 14 April 2015 / Accepted: 17 May 2015

Abstract

In this study we introduce a new model for primary education called ISMS: Improving Student Motivation and Self-esteem. Following a two-year study undertaken in a primary school (n=67), the new model was found to be successful. Students who participated in the research, reported that a course based on ISMS principles was very helpful for strengthening their perceived ability and their motivation to make an effort. They became more enthusiastic, responsible, self-confident, optimistic and determined to succeed. The meaning of such findings is that it is possible to improve key variables having vital influence on student learning and academic performance. The ISMS model was found to be applicable to primary education, in particular, but it may be suitable to secondary schools as well.

Keywords: ISMS, motivation, self-esteem, self-efficacy, academic performance.

Introduction

Motivation is supposed to be one of the most important factors that educators deal with in order to improve learning (Williams & Williams, 2011). It is essential in facilitating a desire to begin to engage in and pursue educational goals (Elliott, Hufton, Willis & Illushin 2005; Fredricks, Blumenfeld, & Paris, 2004; Reeve, 2006). Student motivation is defined as a process where the learners' attention becomes focused on meeting their scholastic objectives and their energies are directed towards realizing their academic potential (Christophel, 1990; Lepper, Greene & Nisbett, 1973).

Student motivation is a vital element that is required for high-quality education. How do we know when students are motivated? They pay attention, they begin working on tasks immediately, they ask questions and volunteer answers, and they appear to be

* Yaron GHILAY, Neri Bloomfield School of Design and Education, Haifa, Israel. yghilay@gmail.com

ISSN:1307-9298

www.iejee.com

happy and eager (Palmer, 2007). Basically, very little if any learning can occur unless students are motivated on a consistent basis.

Self-efficacy is the extent or strength of one's belief in one's own ability to complete tasks and reach goals. Self-efficacy involves the self-evaluation of an individual's perceived skills in reflection of the situation they are experiencing (Bandura, 1982). Bandura is the most notable contributor in postulating ideas within the social learning theoretical framework that are applicable to the notion of student motivation (Lancellotti & Thomas, 2009).

Bandura (1982) presupposes there is a rich interplay within the dynamic process of motivation as the social environment helps in providing feedback about an individual's successful (or unsuccessful) attempts to use their skills. The three-part process (person, behaviour and environment) outlined by Bandura (1999) is known as reciprocal determinism. Self-efficacy can be conceptualized along a continuum with self-doubt at the opposing end to self-efficacy (Zimmerman & Schunk, 2001). Students are presupposed to move along the continuum according to the many different experiences they encounter in reaction to their perceived skills (Bandura, 1999). Researchers indicate self-efficacious beliefs are a powerful influence on the motivational process (Lancellotti & Thomas, 2009). Students who believe that they possess the necessary skills have greater likelihood of attaining higher than average grades (Lancellotti & Thomas, 2009). Researchers' findings suggest self-efficacious beliefs, student motivation and course descriptions are good indicators for predicting student effort because they stimulate attitudinal processes that are future-oriented towards achievement outcomes (Lancellotti & Thomas, 2009). Additionally, another research supports Lancellotti and Thomas' (2009) notion that self-efficacious cognitions feed a person's beliefs concerning self-competence to such a large degree that approach-behaviour toward goals is highly correlated (Ryan & Deci, 2000). Social feedback is one means by which students gather information as to their skill success during a collaborative learning process (Reeve & Deci, 1996). Hence, self-efficacy is both a social and cognitive requirement.

A similar term to self-efficacy is self-esteem. A common definition for this term is as follows:

"Global cognitive and affective/feeling orientation that focuses on how an individual feels about him or herself as a person" (Burnett, 1994, p. 165).

This definition is in line with a description of global self-esteem as overall feelings of self-worth (Lawrence, 1996).

Self-esteem has a pervasive impact on human behaviour (Baumeister, 1999). For example, it has been found that global self-esteem is related to areas such as conformity, attraction, competition, helping, and causal attribution (Campbell, 1990). Furthermore, level of self-esteem has a powerful effect on students' assertiveness, independence, dominance, and ambitiousness (Campbell, 1990); interpersonal skills (Carlock, 1999); and students' perceptions of self-referent (Rudich & Vallacher, 1999) and evaluative feedback (Woo & Frank, 2000). Additionally, evidence suggests that there are positive correlations between global self-esteem and academic performance (Khalid, 1990), self-confidence, success at schoolwork (Lawrence, 1996), and the successful functioning of the individual (Williams & Eden, 1995). The results of these studies highlight the important influence of self-esteem.

Persons' self-esteem is continuously developed throughout their entire life, through life experiences (Orth et. al, 2012). The development of self-esteem starts as early as childhood. Children are largely influenced by their parents at a young age to determine what is right and wrong. If a parent is constantly giving positive reinforcement to a child, the child is more probable to respond and do well (Rudy & Grusec, 2006). However, if children are continuously given negative feedback, or told they were naughty, the more likely that they will begin to believe it (Rudy & Grusec, 2006). As people go through life, they will constantly be faced with judgments from family, friends, or other influencing people, all of which will have an impact on how people see themselves – their self-esteem (Pelham & Swann, 1989).

Multiple studies have shown the importance of the association between academic achievement and self-esteem (Bauemeister et. al, 2003). Studies have shown that a child with high academic performance is much more likely to have high self-esteem, compared to someone with poor academic performance (Bauemeister et. al, 2003).

At this point, it should be mentioned that according to Judge, Erez, Bono & Thoresen (2002), both terms, self-esteem and self-efficacy measure the same single factor and demonstrated them to be related concepts. Therefore, the term self-esteem would be used exclusively from this point on.

Based on the literature mentioned above, it is evident that both motivation and self-esteem are essential variables having an influence on student learning. Therefore, if a method for improving motivation and self-esteem had been found, it could have created much better learning at school.

The new model

The study introduces a new model for primary education called ISMS: Improving Student Motivation and Self-esteem. The model is focused on practical procedures, which can be easily undertaken in every primary school in order to achieve that desired goal. According to the research literature, it is well known that such advancement might affect students' learning significantly and positively.

Unfortunately, many students do not fulfil their intellectual potential because of low motivation and self-esteem. Such a situation might be changed following an improvement of these variables. The new model intends to achieve the following main objectives:

1. Increasing students' perceived ability to fulfil their intellectual potential by strengthening emotional skills:
    a. To "touch the child's soil" and to help him/her to change negative perceptions such as "I cannot/I am unable" to positive believes: "I can/I am able".
    b. To assist students to release emotional barriers preventing them from being available for learning – low motivation and low self-esteem. That can be done by fostering a sense of efficacy, strengthening self-belief and motivation in the context of success in life in general and at school in particular.
2. Assimilating the message that man creates his life as he sees fit. Students have the power to determine their future life in general and in the academic area, in particular.
3. Increasing students' awareness of the importance of necessary components to succeed, such as: belief in the ability to prosper, willpower, setting goals, striving for their achievement and persistence.
4. Increasing students' awareness of difficulty factors, namely, students should realize that such difficulties can be solved through self-determination.

Basic metaphor

The model is based on the fundamental term "Architect," which is a metaphor for creation of life success. It begins by introducing the following phrase: "I am the architect of my life." Students are asked to describe their thoughts relating to "being the architect of my life." The meaning of this slogan is that success in life in general and at school, in particular, depends mainly on the individual, and it requires meticulous pre-planning. Planning of personal career is similar to the process that an architect undertakes while designing a new house. The basic objective of the new model is to nurture high internal locus of control (the extent to which individuals believe that they can control events that affect them). It fits the "self-fulfilling prophecy" which is a prediction that causes itself to become true, namely, if students believe they can study successfully, the probability they would practically succeed, would be much greater, and vice versa.

Following the first discussion, students are requested to answer the question "Why in your opinion, the course is called 'I am the architect of my life'?" Such a discussion can be undertaken in class or via a digital forum in the course website.

General Framework

The model is about to be undertaken in groups of up to 15 students during 14 one-hour lessons undertaken once a week. It is guided by teachers who have learned its principles. It is based on the assumption that perceptions affect behaviour and its main objective is to significantly strengthen motivation to succeed and self-esteem.

Improving motivation to succeed and strengthening self-esteem

The model is based on the following two basic principles:

1. Participating in challenging activities based on creative thinking: students are trained to think "out of the box" in order to find applicable solutions. Such activities take place at the beginning of each meeting in order to assimilate the following message: "in situations where we are stuck in life or/and in studies, it is necessary to think outside the box in order to make a breakthrough for achieving our desired targets."

While dealing with challenging activities, students experience a simulation of real-life situations where people might feel helpless or hopeless concerning certain circumstances. However, deep thinking shows that such a perception is usually wrong because reasonable solutions do exist, even though, they are not easily seen. Such a simulation is about to teach students that in many real-life cases, failures are not inevitable. On the contrary, disappointments can be prevented and success might be achieved if students would be used to believe they can and they would prefer an optimistic view over a pessimistic one. Furthermore, in many occasions, people use to do "more of the same": they move in the same direction instead of thinking creatively what might cause a breakthrough. The fact that somebody did not succeed is not an evidence for being incompetent.

Students are guided to realize that they have the ability to successfully deal with difficult situations, dependent on the adoption of the following two basic perceptions:

a. Belief in the existence of a feasible solution.
b. Action in different ways based on deep thinking for achieving an efficient practical solution.

Following each activity, the perceptions mentioned above are discussed and explained so that students are expected to gradually change their defeatist way of thinking, adopting new assertive views.

Examples:

a. There are six matches, and it is required to use them only in order to build four equilateral triangles.
b. At first, the mission looks impossible. Nevertheless, it might be a simulation of real-life situations in which difficulties look unsolvable initially. After deep and creative thinking, preliminary perceptions are about to change and a simple solution might be found (transition from planar perception to spatial thinking, namely, building a triangular pyramid, including a base and three faces, all of which are equilateral triangles).
c. How many triangles are there in the following drawing?

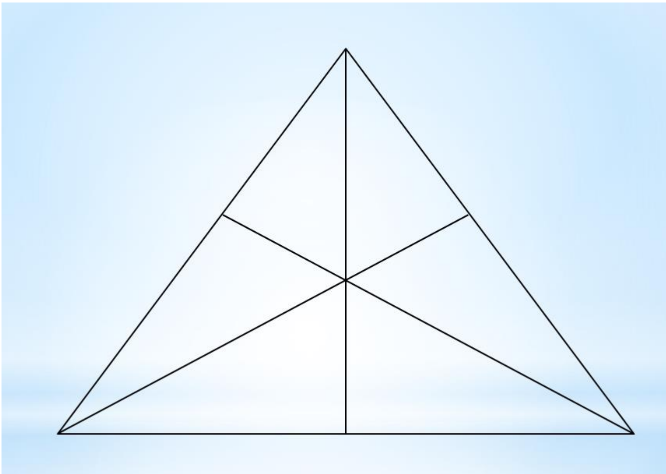


Figure 1. An example for a challenging activity - number of triangles.

At first, it seems that there are only six or seven triangles. Later on, more triangles are viewed (combinations of two, three or six small triangles – overall 16).

2. Developing awareness of vital characteristics for fulfilling personal potential and success: in order to develop such an awareness, students take part in discussions and exercises dealing with the important factors influencing success and potential fulfilment, such as:
    a. Belief in student ability to succeed: students are taught to adopt the following concept: "our thoughts create our world." That perception is introduced by relevant quotes emphasising the great importance of positive thinking. It includes the belief of one self's ability to overcome fears, accepting oneself-positive as well as oneself-negative characteristics. The vital importance of continually making effort, in spite of all difficulties, is stressed repeatedly. A very important view is not to give up while facing difficulties. On the contrary, students learn to realize that it is absolutely crucial to be patient and persistent, in order to eventually achieve success.

In order to assimilate such perceptions, students are given relevant quotes and are asked to discuss the main ideas, such as:

"You have powers you never dreamed of. You can do things you never thought you could do. There are no limitations in what you can do except the limitations of your own mind." (Kingsley, 2006).

"You are today where your thoughts have brought you; you will be tomorrow where your thoughts take you". (Allen, n.d.).

b. Change of attitude on life: famous quotes are introduced in order to stimulate discussion directed at enabling students to change their attitudes on life. Relevant examples of such quotes may be the following:

"A pessimist sees the difficulty in every opportunity; an optimist sees the opportunity in every difficulty" (Churchill, n.d.).

"The longer I live, the more I realize the impact of attitude on life. Attitude, to me, is more important than facts. It is more important than the past, the education, the money, than circumstances, than failure, than successes, than what other people think or say or do. It is more important than appearance, giftedness or skill. It will make or break a company... a church... a home. The remarkable thing is we have a choice everyday regarding the attitude we will embrace for that day. We cannot change our past... we cannot change the fact that people will act in a certain way. We cannot change the inevitable. The only thing we can do is play on the one string we have, and that is our attitude. I am convinced that life is 10% what happens to me and 90% of how I react to it. And so it is with you... we are in charge of our attitudes." (Swindoll, n.d.).

c. Characteristics of success: students are asked to remind and describe real life situations which they faced successfully, including involved emotions and feelings, as well as helpful abilities, strengths and skills. Following that, they are asked also to interview a close relative (father, mother, grandfather, grandmother) and to deal with the relatives' equivalent successful life situations.

Furthermore, students are exposed to ways of achieving success as demonstrated from the point of view of successful celebrities. That is undertaken by reading texts expressing famous people's views towards success. A relevant example is that of Bill Gates (Macabasco-Yanuaria, n.d.):

1. Passion to create things and make a difference.
2. Hard-work and dedication.
3. High emotional intelligence
4. Humility and simplicity.
5. Value of taking one step everyday

Students may learn a lot by being exposed to such quotes and discuss them deeply. They are about to realize that success depends on hard work, it is reached gradually and not at once, and it is dependent on motivation and willingness to advance.

d. Motivation and Self-locus of control: in order to teach students that achievements are based on high self-expectations and hard work, they are asked to choose a quote from a list of proverbs and to explain the reasons for their selection. The following are relevant examples:

"Just remember, you can't climb the ladder of success with your hands in your pockets" (Lewis, 2012).

"A leader is a dealer in hope" (Bonaparte, n.d.).

"People who say it cannot be done should not interrupt those who are doing it" (Bernard-Shaw, n.d.a).

"People are always blaming their circumstances for what they are. I don't believe in circumstances. The people who get on in this world are the people who get up and look for the circumstances they want, and, if they can't find them, make them." (Bernard-Shaw, n.d.b).

"People do not lack strength, they lack will" (Hugo, n.d.).

"Success is not achieved without labour" (Ibn Ezra, n.d.).

"You are good enough, smart enough, beautiful enough and strong enough. Believe it and never let insecurity run your life" (Davis, 2012).

Such a discussion can be helpful for students to realize that in order to reach desired goals, effort should be invested, they have to be optimistic and believe in their own capability. Furthermore, they should believe they have the strength to influence and that most daily situations depend mainly on themselves and not on the external world. It should be stressed at that point that in order to reach a conceptual meaningful change, such discussions should be taken place repeatedly. Such a comprehensive change depends on continuous activities.

Method

General Background

The study framework: evaluating the effectiveness of ISMS model

Primary school students (School A, *n*=67) who studied in a course based on the principles of the ISMS model, participated in a study intended to evaluate the course influence on their attitudes. Therefore, a pre-experiment design, including one group pre-test - post-test, has been chosen (Cohen, Manion & Morrison, 2007). The field experiment was undertaken twice: the first one, during the year 2012-13 and the second, in 2013-14. Students' level of motivation and self-esteem were examined before and after the ISMS course in order to find out if there is a significant difference between the two measurements. The meaning of such a hypothetical significant gap is that implementing the new model can improve students' motivation and/or self-esteem. Such a result might have an important positive influence on students' future learning and consequently, in the long run their achievements are likely to be better.

The research question

The research question intended to measure the effectiveness of the new ISMS model in primary schools. The model's effectiveness was measured relating to hypothetical improvement of two main variables: students' motivation and self-esteem.

The following research question was worded:

What influence does ISMS model have on primary school students' motivation and self-esteem?

Population and Samples

Population: The population addressed through the study included all students at school A which is a primary school located in a city close to Tel-Aviv. The institution has six grades (from first to sixth), there are approximately 500 students overall and 35 teachers.

Samples: the study was based on the following two samples, including four grades (3th-6th, age 11 to 14):

Sample 1: year 2012-13 - 38 students.

Sample 2: year 2013-14 - 29 students.

Overall: 67 students.

Students were asked to answer the same questionnaire before and after participating in a course based on ISMS principles, during two academic years (2012-2013, 2013-2014). The aim of the study was to measure their level of motivation and self-esteem and to check hypothetical differences between both measurements.

The questionnaire was anonymous, and the rate of response was 100%.

Tools

In order to answer the research question, a questionnaire, including 26 closed statements and two open ended ones was prepared. For each question, respondents were requested to mention their views on the following Likert five-point scale:

1 Strongly disagree.
2 Mostly disagree.
3 Moderately agree
4 Mostly agree.
5 Strongly agree.

The open-ended questions were designed to accomplish the main data gathered by the quantitative part of the questionnaire, as follows:

1. Was the ISMS course helpful for improving your own belief in your ability to succeed?
2. Did the course have any influence on your will to succeed and making effort at school?

Data Analysis

In order to examine the validity of the questionnaire, factors' reliability was calculated (Cronbach's alpha). Item analysis was undertaken as well in order to improve reliability. Based on the reliability found, the following four factors were calculated:

1. Motivation – pre-course.
2. Self-esteem – pre-course.
3. Motivation – post-course.
4. Self-esteem – post-course.

For each factor, there was found a high value of reliability (ranges from 0.738 to 0.914). Every factor has been determined by calculating the mean value of the items composing it.

For each factor, a mean score was calculated (including standard deviation). The following statistical tests have been undertaken as well ($\alpha<=0.05$):

1. Independent Samples T-test: in order to check significant differences of factors' means between 2012-13 and 2013-14.
2. Paired Samples T-test: it was conducted for checking significant differences between pre-course and post-course factors (for both motivation and self-esteem).

Table 1 summarizes the four factors, the items composing them and the reliability.

Table 1. *Factors and reliability*

Factors	***Questionnaire's questions***
Motivation *Pre-course: Alpha=0.880* *Post-course: Alpha=0.914*	It is important for me to learn everything that the teacher teaches at class. I strive for good grades at school. Even when I do not succeed in a test, I am trying to learn from my mistakes. The studies at school are important for me. I have a strong will to succeed at school. I prepare myself carefully before each test. I'm trying to do my homework well. I'm trying to learn even when the lesson is boring. I take responsibility in order to succeed at school. I set goals in order to make progress at school. I'm making plans to help me making progress at school. I make an effort at school until I succeed. I am ready to invest time in order to succeed at school. I meticulously prepare my school assignments. I am willing to continue to invest at school, even if I failed. When I fail in a certain subject, I continue to make an effort. I'm able to think creatively in order to deal with difficulties at school. When I fail in a certain subject, I know how to find creative solutions that would help me succeed.
Self-esteem *Pre-course: Alpha=0.738* *Post-course: Alpha=0.772*	I am a good student. I think I have the talent to succeed at school. I have knowledge and understanding in many areas. I am able to succeed at school. I can cope well with most learning tasks. I am organized pretty well with my time. I think my teachers appreciate me. I believe I can do well at school.

Results

There was no significant difference between the years 2012-13 and 2013-14 concerning the mean scores of all four factors, as follows (Independent Samples T-test, $\alpha \leq 0.05$):

Motivation – pre-course: $t_{(65)} = 1.933,\ p = .058$

Self-esteem – pre-course: $t_{(65)} = 1.211,\ p = .23$

Motivation – post-course: $t_{(62)} = 1.031,\ p = .307$

Self-esteem – post-course: $t_{(62)} = 1.341,\ p = .185$

It means that there was a replication of the results found in the first year (2012-13) also in the second one (2013-14). It strengthens the findings and gives them more validity. Therefore, mean factors' scores are presented for both years together in table 2.

Table 2. *School A – mean factors for 2012-13 and 2013-14 together (Pre/Post-course).*

Factors		*N*	Mean	S.D
Motivation	Pre-course	64	3.9786	.55
	Post-course	64	4.1794	.57
Self-esteem	Pre-course	64	3.9040	.61
	Post-course	64	4.1895	.55

Table 2 introduces the following findings:
Relating to motivation (t-test, $\alpha \leq 0.05$), there is a significant difference between pre-course (3.9786) and post-course (4.1794) results ($t_{(63)} = -2.663, p = .01$). Concerning self-esteem, the gap between pre-course (3.9040) and post-course (4.1895) results was found to be significant as well ($t_{(65)} = -3.234, p = .002$). The meaning of these findings is that a course based on ISMS model, has a positive influence on improving of both motivation and self-esteem. The open-ended questions strengthen the closed statements as shown in the following quotes (school A, 2012-13/2013-14):

> "*The course improved my belief in my ability to succeed both at school and in life. In case I do not succeed in something, I realized that I should never give up. The course increased my willingness to make an effort at school. I learned that if I wish to succeed I have to think out of the box".*

> *"Since the course, I am enthusiastic to succeed. I realized that I have to take responsibility for myself, and if I want something, nothing would stop me."*

> *"The course improved my courage to study and increased my self-confidence."*

> *"The course taught me that many things which looked to me insoluble in the past can be solved if I am determined."*

> *"I learned that if I want, I can. I began to believe in myself."*

> *"The course encouraged me to believe that I am able to succeed."*

> *"Following the course, I learned to be much more determined. If I experience any difficulties, I fight and do not give up."*

> *"I studied to think positively and to be persistent all the way to achieve my desired goals."*

> *"All my way of thinking has been changed. I started thinking creatively and began to believe in my own ability."*

> *"I discovered new abilities which I have never known."*

> *"It is very important that many other school students would study in the course because it changes the way of thinking."*

The quotes mentioned above stress the very important contribution of the ISMS course to primary school students. It improved their whole way of thinking, their self-esteem and their motivation to make an effort. Students learned to believe they have significant abilities, and they fully understood that in order to fulfil their potential, they should invest much effort and never give up. Such a conceptual change might have a substantial influence on their future achievements at school, in particular, and in life in general.

Conclusion

According to the study's results, the ISMS model was found to be a practical and successful tool for improving primary school students' motivation and self-esteem. This conclusion is based on two components:

1. Quantitative part (questionnaire's closed questions): there were found significant differences between the initial levels of both variables and their final values. The positive results were gained after a relatively short period of time: a 14-hour course based on the ISMS model. Besides, the same results received in the first year of the study (2012/13), repeated in the second one as well (2013/14).
2. Qualitative part (questionnaire's open-ended questions): additional detailed evidence was achieved by the qualitative part of the research. According to students' verbal responses, the model was found to be very helpful and effective for strengthening their perceived ability. It had a substantial contribution for improving their persistence towards goal seeking and their motivation to make an effort. Furthermore, students became more enthusiastic, responsible, self-confident, optimistic and completely determined to succeed. They learned how to adopt positive and creative thinking and in what way to discover new capabilities, which have been hidden so far.

The repetition of the quantitative results during two years and the mix of both methods (quantitative and qualitative) strengthen the validity of the whole research substantially.

The meaning of such findings is that it is quite feasible to improve key variables having vital influence on student learning and academic performance (Christophel, 1999; Elliott et al., 2005; Fredricks et al., 2004; Khalid, 1990; Lepper et al., 1973; Reeve, 2006). Moreover, such a change might be undertaken within a primary school framework without external assistance or additional substantial expenditure.

The study's findings might be applicable for improving learning and academic performance, particularly in primary schools. However, the new model might be suitable for other kinds of schools as well, such as junior-high or high schools. It might be used to create even longer courses than the one examined, or it can even be added to the regular timetable of each grade as a permanent lesson. Probably, expansion of the courses based on ISMS principles, might give better results.

As mentioned earlier, the new model deals mainly with changing students' attitudes and perceptions relating to their ability and self-confidence. In order to assimilate such a change at schools, teachers should be trained for acquiring relevant knowledge required for guiding students. The success is completely dependent on teachers' qualifications and belief that such a model can entirely change students' way of thinking. The next step which may strengthen the ISMS model can be an additional course that would train parents how to nurture their children's motivation so the mission would not be school dependent only. A combination of home and school might be synergetic, leading to a comprehensive improvement of student's motivation and self-esteem. Such a change will probably lead students to more effective learning and consequently, better achievements.

• • •

References

Allen, J. (n.d.). BrainyQuote.com. Retrieved August 5, 2014, from http://www.brainyquote.com /quotes/quotes/j/jamesallen133802.html.

Bandura, A. (1999). Social cognitive theory: An agentic perspective. Asian Journal of Social Psychology, 2, 21-41.

Bandura, A. (1982). Self-efficacy mechanism in human agency. American Psychologist, 37, 122-147.

Baumeister, R. F., Campbell, J. D., Krueger, J. I., & Vohs, K. D. (2003). Does High Self-Esteem Cause Better Performance, Interpersonal Success, Happiness, or Healthier Lifestyles? Psychological Science in the Public Interest, 4(1), 1-44.

Baumeister, R. F. (1999). The self in social psychology: Key readings in social psychology. Philadelphia: Psychology Press.

Bernard-Shaw, G. (n.d.a). BrainyQuote.com. Retrieved August 5, 2014, from http://www.brainyquote.com/quotes/quotes/g/georgebern163003.html.

Bernard-Shaw, G. (n.d.b). BrainyQuote.com. Retrieved August 5, 2014, from http://www. quotationspage.com/quote/26793.html

Bonaparte. N. (n.d.). Quotation Details. Retrieved August 5, 2014, from http://www.brainyquote. com/quotes/quotes/n/napoleonbo106371.html

Burnett, P. C. (1994). Self-concept and self-esteem in elementary school children. Psychology in the Schools, 31, 164-171.

Campbell, J. D. (1990). Self-esteem and clarity of the self-concept. Journal of Personality and Social Psychology; 59(3), 538-549.

Carlock, C. J. (1999). Social system and self-esteem. Enhancing self-esteem[Srd ed.), Philadelphia: Accelerated Development, Inc.

Christophel, D.M. (1990). The relationship among teacher immediacy behaviours, student motivation and learning. Communication Education, 39, 323-340.

Churchill, W. (n.d.). BrainyQuote.com. Retrieved August 5, 2014, from http://www.brainyquote.com/quotes/quotes/w/winstonchu103739.html.

Cohen, L., Manion. L & Morrison, K. (2007). Research Methods in Education. New York: Routledge.

Davis, T. (2012, August 2). Love ThySelf. Retrieved August 5, 2014, from http://bellafyyourself.blogspot.co.il/2012/08/you-are-good-enough-smart-enough_6330.html

Elliott, J.G., Hufton, N.R., Willis, W., & Illushin, L. (2005). Motivational, engagement and educational performance: International perspectives on the context of learning. New York: Palgrave Macmillan.

Fredricks, J.A., Blumenfeld, P.C., & Paris, A.H. (2004). School engagement: Potential of the concept, state of the evidence. Review of Educational Research, 74, 59-109.

Hugo, V. (n.d.). BrainyQuote.com. Retrieved August 5, 2014, from http://www.brainyquote.com /quotes/quotes/v/victorhugo378733.html

Ibn-Ezra, M. (n.d.). Among Quotation Marks. Retrieved August 5, 2014, from http://www.pitgam.net /quote/1631/1/ (in Hebrew).

Judge, T.A., Erez, A., Bono, J.E., Thoresen, C.J. (2002). Are measures of self-esteem, neuroticism, locus of control, and generalized self-efficacy indicators of a common core construct?. Journal of Personality and Social Psychology, 83 (3): 693–710.

Khalid, R (1990). Self-esteem and academic achievement: An investigation of ethnic and sex differences. Journal of Behavioural Sciences, 1(1), 3-17.

Kingsley, D.P. (2006, April 19). Positive-Thought-of-the-Week. Retrieved August 5, 2014, from http://positive-thought-of-the-week.blogspot.co.il/2006/04/you-have-powers-you-never-dreamed-of.html.

Lancellotti, M., & Thomas, S. (2009). To take or not to take: Effects of motivation, self-efficacy, and class-related factors on course attitudes. Marketing Education Review, 19, 35-47.

Lawrence, D. (1996). Enhancing self-esteem in the classroom. London: Paul Chapman.

Lepper, M.R., Greene, D., & Nisbett, R.E. (1973). Undermining children's intrinsic interest with extrinsic reward: A test of the over-justification effect. Journal of Personality and Social Psychology, 28, 129-137.

Lewis. W. (2012, August 22). You can't climb the ladder of success with your hands in your pockets. Retrieved August 5, 2014, from http://www.elephantjournal.com/2012/08/you-cant-climb-the-ladder-of-success-with-your-hands-in-your-pockets/.

Macabasco-Yanuaria, M.L. (n.d.). Bill Gates: Attitudes of Successful People. Retrieved August 5, 2014, from http://lifetofullest.com/bill-gates.

Orth, U., Robins, R. W. & Widaman, K. F. (2012). Life-span development of self-esteem and its effects on important life outcomes. Journal of Personality and Social Psychology, 102(6), 1271-1288.

Palmer, D. (2007). What Is the Best Way to Motivate Students in Science? Teaching Science-The Journal of the Australian Science Teachers Association, 53(1), 38-42.

Pelham, B. W., & Swann, W. B. (1989). From self-conceptions to self-worth: On the sources and structure of global self-esteem. Journal of Personality and Social Psychology, 57(4), 672-680.

Reeve, J. (2006). Teachers as facilitators: What autonomy-supportive teachers do and why their students benefit. The Elementary School Journal, 106, 225-236.

Reeve, J., & Deci, E. L. (1996). Elements of the competitive situation that affect intrinsic motivation. Personality and Social Psychology Bulletin, 22, 24–33.

Rudich, E. A., & Vallacher, R. R. (1999). To belong or to self-enhance? Motivational bases for choosing interaction partners. Personality and Social Psychology Bulletin, 25(11), 1387-1404.

Rudy, D., & Grusec, J. E. (2006). Authoritarian parenting in individualist and collectivist groups: Associations with maternal emotion and cognition and children's self-esteem. Journal of Family Psychology, 20(1).

Ryan, R.M., & Deci, E.L. (2000). Self-Determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55, 68-78.

Swindoll, C. R. (n.d.). Goodreads.com. Retrieved August 5, 2014, from http://www.goodreads.com /quotes/267482-the-longer-i-live-the-more-i-realize-the-impact.

Williams, H., & Eden, C. (1995). Gender and IT in the primary classroom: Building confidence through laptops. Computer Education, 8, 10-14.

Williams, K.C & Williams, C.C (2011). Research in Higher Education Journal, 12, 1-23.

Woo, T. O., & Frank, N. (2000). Academic performance and perceived validity of grades: An additional case for self-enhancement. Journal of Social Psychology, 140(2), 218-226.

Zimmerman, B.J., & Schunk, D. H. (2001). Self-regulated learning and academic achievement. Mahwah, New Jersey: Lawrence Erlbaum Associates.

www.iejee.com

This page is intentionally left blank

International Electronic Journal of Elementary Education, 2015, 7(3), 399-422.

An Alternative Route to Teaching Fraction Division: Abstraction of Common Denominator Algorithm

İsmail Özgür ZEMBAT *
Mevlana (Rumi) University, Turkey

Received: February 2015 / Revised: May 2015 / Accepted: May 2015

Abstract

From a curricular stand point, the traditional invert and multiply algorithm for division of fractions provides few affordances for linking to a rich understanding of fractions. On the other hand, an alternative algorithm, called common denominator algorithm, has many such affordances. The current study serves as an argument for shifting curriculum for fraction division from use of invert and multiply algorithm as a basis to the use of common denominator algorithm as a basis. This was accomplished with the analysis of learning of two prospective elementary teachers being an illustration of how to realize those conceptual affordances. In doing so, the article proposes an instructional sequence and details it by referring to both the (mathematical and pedagogical) advantages and the disadvantages. As a result, this algorithm has a conceptual basis depending on basic operations of partitioning, unitizing, and counting, which make it accessible to learners. Also, when participants are encouraged to construct this algorithm based on their work with diagrams, common denominator algorithm formalizes the work that they do with diagrams.

Keywords: Teaching fraction division, abstracting common denominator algorithm, curriculum development

Introduction

Arithmetic operations, and teaching and learning of them have always been an interest for mathematics education community. In his historical analysis, Usiskin (2007) pointed out that operations (especially on fractions) still preserve its importance in school mathematics and they should be given enough emphasis. Division is one such operation that has taken considerable attention by many researchers. The attraction to this operation is partly because of its complexity. This complexity is caused by the fact that division requires a meaningful organization of a variety of interconnected relationships (Thompson, 1993). In other words, division can be considered as a relationship between three quantities (dividend, divisor, and quotient) and an invariant relationship exists

* İsmail Özgür ZEMBAT, Mevlana (Rumi) University, Faculty of Education, Turkey, Phone: +90 (533) 4842026, E-Mail: izembat@gmail.com

ISSN:1307-9298

www.iejee.com

among these three quantities (Post, Harel, Behr, & Lesh, 1991). Here, the invariant relationship is meant to describe the multiplicative relationship between divisor and dividend, divisor and quotient, and dividend and quotient. Abstractly thinking about these relationships among the quantities in a division situation is difficult even for most teachers (Simon, 1993), which is one of the reasons why division takes considerable attention by many researchers.

Division is a complex operation to conceptualize and treatment of it within fractional domain makes it even more complicated for learners (Borko, Eisenhart, Brown, Underhill, Jones, & Agard, 1992; Ma, 1999; Sowder, 1995). The fact that division of fractions require conceptual proficiency in both division and fraction concepts (Armstrong & Bezuk, 1995) makes this area of mathematics problematic in the upper elementary and middle grades. One of the reasons for such problem is the fact that fractions, as part of the rational number set, itself has several different interpretations (Kieren, 1993) and division acting on that set makes this area more problematic. Therefore, division of/by fractions deserves a special attention in school mathematics.

Even though this topic deserves a special attention in school mathematics, research studies point out that teachers' understanding of this topic is not strong enough and they are not well-equipped to teach it conceptually. Teachers' understanding of division in fractional domain is closely associated with remembering a particular algorithm, invert and multiply algorithm (Ball, 1990), which is very poorly understood (Borko et al., 1992; Zembat, 2007) and dependent on rote memorization without conceptual basis (Li & Kulm, 2008; Simon, 1993). Teachers are not able to provide concrete examples or any rationale for invert and multiply algorithm (Ma, 1999). In fact, making sense of such an algorithm and conceptualizing it using the inverse relationship between multiplication and division is very difficult (Contreras, 1997; Tzur & Timmerman, 1997). In spite of this, a majority of teachers use it as a primary way to teach their students division of fractions (Ma, 1999). Most of the traditional mathematics textbooks make their introduction to division of fractions with this algorithm too. When explaining her previous experiences on teaching fraction division with the invert and multiply algorithm, a participant teacher from Sowder and her colleagues' (1998) study commented that

> "[…] one of my students said, "why do you flip it and why are we multiplying? This is division." And she [referring to the student teacher] says "Because I just told you to do it." And I sat there and thought, "Boy that was a wonderful question, and that was a very common answer." And I don't know how I would […] have to […] think about it to give more concrete examples." (p. 46)

Teachers' lack of necessary mathematical background to delve into the rationale for algorithms such as invert and multiply algorithm (hereafter abbreviated as IMA) is one side of the issue whereas feasibility of this algorithm is another. From a curricular stand point, the traditional IMA for division of fractions provides few affordances for linking to a rich understanding of fractions. On the other hand, an alternative algorithm, called common denominator algorithm (hereafter abbreviated as CDA), has many such affordances as explained in the following section.

The current study serves as an argument for shifting curriculum for fraction division from use of IMA as a basis to the use of CDA as a basis[1]. This was accomplished with the analysis of learning of two prospective elementary teachers being an illustration of how to

[1] Note that in countries like US or Turkey, education authorities (e.g., National Council of Teachers of Mathematics for US and Ministry of Education in Turkey) make curricular recommendations to teach CDA but most textbooks ignore them and used IMA as an initial basis to teach fraction division.

realize those conceptual affordances. The following section elaborates on the affordances and constraints of both algorithms through use of a mathematical analysis.

Meaning of CDA and IMA – Affordances They Provide?

Sharp and Adams (2002) indicated that IMA does not give learners enough opportunity to invent their own algorithm because of its complex and algebraically situated mathematical structure. This is not to say that IMA should not be included in school mathematics at all. On the contrary, as Sharp and Adams (2002) stated, learning of it should be delayed until after learners gained enough experience about the conceptual and procedural basis for division of fractions. Moreover, as a result of their synthesis of the extensive literature review in this area Sharp and Adams (2002) pointed out that CDA is most useful in developing a meaning for arithmetic as detailed below; it is meaningful and easier to be based on whole numbers whereas IMA as given in schools encourages learners to memorize it since learners find little sense in the procedure. The meaning of CDA is detailed below.

Given that the denominators of the dividend and divisor are relatively prime, an algebraic interpretation of CDA can be given as follows:

$$\frac{A}{B} \div \frac{C}{D} = \frac{A \times D}{B \times D} \div \frac{C \times B}{D \times B} = \frac{A \times D}{C \times B}$$

Such an interpretation suggests that CDA with the above restrictions includes two phases: finding the common denominator for the dividend and divisor, and dividing the numerators. Details of this algorithm are given below.

Considering the division operation as a multiplicative comparison of two quantities, in other words as measuring one quantity with respect to other, requires making such a comparison/measurement on a common basis. This is not easily done if the dividend and divisor have different denominators. For example, comparing 1/2 to 4/5 is much more difficult for the problem (4/5)÷(1/2) than comparing 1/4 to 3/4 for the problem (3/4)÷(1/4) since latter one has a common basis, namely fourths, to compare divisor and dividend (e.g., 3 of the 1/4 can go into 3/4) whereas the first one does not have such a common basis because different denominators (e.g., fifths and halves) suggest different size-units to compare. Therefore, transforming the given two quantities into a form that enables one to make a direct multiplicative comparison between dividend and divisor is necessary (i.e., turning (4/5)÷(1/2) to (8/10)÷(5/10)). Once the two quantities are of the same type (with same denominators), division operation that is given in the fractional system can be interpreted as if acting in whole number system, which means dividing the numerators. For example, after turning (4/5)÷(1/2) to (8/10)÷(5/10) the question of 'how many 5/10 are in 8/10?' is same as 'how many 5 are in 8?' since we compare same size units, namely tenths). Therefore, teaching CDA provides learners an opportunity to tie their experience in this area to their whole number division knowledge.

The IMA, on the other hand, requires students to understand concept of inverse as part of the group theory as explained below and it depends on the use of multiplication instead of addition. There are two versions of applying IMA detailed below. In the first version one needs to understand that in order to find the answer for $(A/B)\div(C/D)$, the divisor, C/D, needs to be eliminated through multiplication of the inverse of divisor. Therefore, both the dividend, A/B, and the divisor, C/D, are to be multiplied by the inverse of divisor, D/C. In the second version one needs to understand that dividing A/B by C/D is equivalent to finding a number of C/D that is equivalent to A/B and understand the multiplying by inverse. Both versions of IMA are quite similar and seem to be hard to conceptualize by students (Sharp & Adams, 2002).

Version 1: $\frac{A}{B} \div \frac{C}{D} = \frac{\left[\frac{A}{B}\right] \text{x} \left[\frac{D}{C}\right]}{\left[\frac{C}{D}\right] \text{x} \left[\frac{D}{C}\right]} = \left(\left[\frac{A}{B}\right] \text{x} \left[\frac{D}{C}\right]\right) \div 1 = \left[\frac{A}{B}\right] \text{x} \left[\frac{D}{C}\right]$

[Version 1 using group theory: $\frac{a}{b} = \frac{a \times b^{-1}}{b \times b^{-1}} = \frac{a \times b^{-1}}{e} = [a \times b^{-1}] \div e = a \times b^{-1}$]

Version 2: $\frac{A}{B} \div \frac{C}{D} = X \Rightarrow \frac{A}{B} = X \times \frac{C}{D} \Rightarrow \frac{A}{B} \times \frac{D}{C} = X \times \frac{C}{D} \times \frac{D}{C} \Rightarrow X = \frac{A}{B} \times \frac{D}{C}$

[Version 2 using group theory: $a \div b = X \Rightarrow a = X \times b \Rightarrow a \times b^{-1} = X \times b \times b^{-1}$ $\Rightarrow X \times e = a \times b^{-1} \Rightarrow X = a \times b^{-1}$]

Even though the current literature points to the ways in which students and teachers reason about division of fractions and related algorithms, a limited number of studies suggested ways to think about developing a solid understanding of algorithms. An articulation of what it takes to abstract algorithms and a detailed description of the associated processes are necessary to design effective instruction. The current study uses an approach to help prospective teachers develop an understanding of CDA by referring to some of the activities (partitioning, unitizing[2], and counting) that are already available to them. In so doing, it investigates the following research question: *What are the conceptual affordances of CDA as reflected in the learning of two prospective elementary teachers*? The purpose of this study is not to generalize the findings gained from two participants to whole population of teachers. Instead, the purpose is to analyze the learning of two prospective elementary teachers being an illustration of how to realize the conceptual affordances that the CDA provides. The theoretical framework guiding this research is detailed below.

Theoretical Framework

Reflection on Activity-Effect Relationship framework (Simon, Tzur, Heinz, & Kinzel, 2004) and Piaget's (2001) description of different types of abstraction were used to design the instructional sequence and to explain participant prospective teachers' development of CDA in this study. In their framework that explains conceptual advancements, Simon and his colleagues (2004) proposed a model based on individuals' own (mental) activities and their reflections on those activities.

According to this framework, in a given problem situation, the learner is the one who sets the *goal*, which is the desired outcome toward which an activity is carried. For instance, a given problem would be "a cake requires 1/8 kg of sugar, how many cups of

[2] The term *unitizing* here refers to "the size chunk one constructs in terms of which to think about a given quantity" (Lamon, 1996, p.170). For example, turning a word problem modeling (3/4)÷(1/3) into (9/12)÷(4/12) by considering 1/3 as a unit of 4(1/12-unit)s and 3/4 as a unit of 9(1/12-unit)s are examples of unitizing 1/3 and 3/4. Through such unitizing one can reinterpret the given situation in the word problem in light of these new quantities.

sugar can be made with 3/4 kg of sugar?" and learner may be asked to solve it using diagrams only. The learner then may set the goal for this problem as "how many 1/8 are in 3/4?" This goal setting is dependent on the learner's available understandings. For example, here the learner may have the understanding of meaning of fractions, understanding of division of whole numbers and counting. Once the goal is set, then the learner pursues it based on his or her activity. Here, *activity* is considered as a mental action engaging the learner in service of reaching the set goal. To reach this set goal, the learner calls on an *activity sequence* (sequence of actions to reach the goal) that is already a part of his or her current conceptions. For our sample problem an activity sequence may involve: drawing 3/4, repartitioning 3/4 to make 1/8s, and counting number of 1/8s. As the learner engages in the activity (sequence), she or he attends to the *results* of it. For the sample problem situation the result of repartitioning 3/4 gives 6/8. Since the learner is the one who sets the goal, the assumption in this framework is that she or he can judge what results get the learner closest to the goal and what results cause deviation from the goal. Each attempt of going through the activity sequence and attempting to the results of it is recorded mentally as an *experience*. The learner mentally compares these records of experience, which results in his or her recognition of pattern(s) or regularities. For our sample problem the learner may think that the first question asks about number of 1/8 in 3/4, the second question asked about number of 3/5 in 9/4, etc., and realize the pattern that "so all questions asks number of one quantity within another." Through reflection on these regularities and patterns, the learner makes an *abstraction* that all such problems ask for the number of one quantity within another.

Here, abstraction is considered as the mechanism of constructing relationships in Piaget's (1971) terms. Piaget (2001) identified two types of abstraction: *empirical abstraction* that is ranging "over physical objects or material aspects of one's own actions" (Piaget, 2001, p.30), and *reflecting abstraction* that is the abstraction of the effects of actions (Piaget, 1983), abstracting the relationships between actions (Piaget, 1964), or abstracting the properties of action coordination (Piaget, 2001, p.30). According to Piaget, reflecting abstraction is the process by which new, more advanced conceptions develop out of existing conceptions.

In designing the current study, the aforesaid theoretical constructs were used for two distinct purposes. First, the analysis of fraction concepts serves to chart the learners' conceptual development through the process of instruction. Second, constructivist theorizing informs the pedagogical approach used in the study. In this sense, this study used a theory-based instruction design that only took into consideration what participants already had available as knowledge and helped them learn conceptions that were more complex than the ones they already had. The instruction was used as a main source of facilitating conceptual development of CDA.

Method

This study was based on a teaching experiment for which I benefited from Steffe and Thompson's (2000) teaching experiment methodology. In the current study, during the data gathering process, I acted as the teacher-researcher instructing two prospective elementary teachers and benefited from three other doctoral students who helped in observing the sessions, data gathering, and partial on-going data analysis. These outside observers witnessed the occurrences that took place in the teaching sessions.

The study consisted of ten teaching sessions and (pre- and post-) clinical interviews. The overall goal of the part of the study reported here was to promote and study participant prospective elementary teachers' conceptual development of the CDA to better understand the conceptual affordances provided by CDA. Therefore, this article basically draws on the analysis of the last two teaching sessions that was mainly designed to promote an understanding of the CDA. A detailed description of all sessions is provided in subsequent sections of the article.

Participants and Selection Criteria

The participants were two prospective elementary teachers from a northeastern U.S. university, who were in the fourth year of their elementary teacher certification program. One of the important factors that affected the selection of participants was the volunteers' knowledge of mathematics. I looked for volunteers who had a very basic understanding of: (a) Fractions, including what a fraction was, knowing how to name, show and represent them, and knowing what numerator and denominator meant; (b) Carrying out basic arithmetic operations on whole numbers and knowing what they meant; (c) Equivalent fractions. In addition, they were not to know about CDA for fraction division. Volunteers' initial understandings were assessed through one-on-one interviews and the ones who met the above criteria were invited to participate in the study. Two of them agreed to commit to the study for a whole semester.

There are several reasons for working with such a limited number of participants. Tracing the conceptual development of learners is very hard in classroom settings since those settings are comprised of a variety of different variables. Having limited number of participants helped me focus on their progress more closely as they engaged in the given task sequence and as they reflected on that sequence. It may be feasible to engage a classroom of learners in a task sequence but it is hard to investigate what aspects of the given task sequence caused difficulty for individuals, how individuals reason about those tasks, or how they reflect on those tasks. In addition, with a few number of learners it is more convenient for the teacher-researcher to facilitate participants' thinking, have them listen to each other, analyze and question each other's solutions, and purposefully reflect on what they did. By having only two participants, I had very few variables left at hand with respect to teaching and learning, and more time to zoom in on the aspects of participants' conceptual development of CDA. This approach is also supported by Steffe (1991) and Simon, Saldanha, McClintock, Akar, Watanabe, and Zembat (2010).

Data Sources and Data Collection

The data consisted of videotapes and audiotapes of the teaching sessions and of one-on-one interviews, the participants' written work produced during the teaching sessions and during the one-on-one interviews, and the field notes taken during and after the teaching sessions. Two interviews, the pre-interview and post-interview, were conducted to gain insight into participants' available mathematical understandings.

The participants (with the pseudonyms, Nancy and Wanda) agreed to meet twice a week, each for two hours and the teaching sessions were completed in five weeks. I designed the teaching sessions to be conducted in a particular format. Specifically, the participants were constantly encouraged to share their ideas, make conjectures, and justify those conjectures. They were not to use any arithmetic operation or algorithm unless they were told to do so. In all the teaching sessions, they were limited to diagrams and the available materials as primary sources for reference[3]. I then modified this sequence, as needed, in response to my analyses of the students' mathematical activity.

[3] Some of the initial ideas for the teaching sequence came from a set of problems designed by Prof. Martin A. Simon and then I further developed that sequence by drawing on participants' development throughout the teaching experiment. Prof. Simon was my PhD dissertation advisor at the Pennsylvania State University (USA) by the time I collected this data.

Throughout the teaching sessions, one of the three co-researchers operated a digital camcorder and an audio recorder, while at least one of the other co-researchers observed the sessions from a secluded corner of the room where she or he did not interfere with the recording or the implementation of the sessions. The focus for the observers was to capture participants' work as much as possible for analysis and to keep field notes pertinent to the important moments that transpired in the sessions. I myself taught the sessions without any interruption from the other researchers.

Tasks for Teaching Sessions 1-8 and Participants' Abstractions

As previously mentioned, there were total of ten teaching sessions. What follows is a brief description of these ten sessions and the participants' available abstractions before the last two teaching sessions.

First two sessions were about helping participants develop an abstraction of quotitive situations as division with fractions. The first teaching session included four main sections: Section 1 consisted of five real world problems modeling quotitive division, which need to be solved using diagrams only; Section 2 consisted of a problem asking about the commonality of the previous five problems and writing a generalization describing the commonality; Section 3 included a problem asking about whether the provided two real world problems (one modeling multiplication of fractions, another modeling division of fractions) fit the generalization provided by participants without actually solving them; Section 4 asked participants to create their own word problems that fit the generalization they already described. Throughout this session, the participants' work was limited to diagram use and the word "division" was absent. Even though the participants went through all the given tasks successfully in the first session, they were not able to create their own word problems modeling division of fractions at the end of the session. One of them created a problem that modeled a whole number division that is not appropriately structured whereas the other participant created a multiplication problem. This result pushed me to modify the tasks for the second session.

The second session, therefore, included a task sequence that helped participants make an abstraction of multiplication with proper fractions as quantification of the part of a given quantity in terms of the given quantity (e.g., (1/4)×(3/7) means how big 1/4 of 3/7 is). What followed this sequence in the second teaching session was another task sequence to help participants to abstract division of fractions, which was quite similar to the sequence given in the first teaching session. Then the participants were asked to make a comparison between the two sets of activities (one for multiplication with fractions, another for division of fractions) once they went through those. In this way, they had the opportunity to compare the activity sequences for both operations, made generalizations for those operations and compare those based on the activity sequences they went through. At the end of these two sessions, the participants' abstraction of division becomes dependent on quotitive situations whereas before the sessions it was about arithmetic relationships between dividend and divisor that gives quotient. In other words, they now considered the quotitive division (of fractions) as modeling quotitive situations and as an investigation of the number of one quantity within another quantity as opposed to a simple arithmetic operation that helps them find the missing factor, quotient, given two other factors; dividend and divisor. Namely, they can now think about questions like (3/4)÷(1/2) with the understanding that it models 'how many 1/2 are in 3/4?' instead of thinking about that question as finding the value of X in $3/4 \div 1/2 = X$.

Sessions 3, 4, and 5 included tasks to help participants make a distinction between partitive and quotitive division situations in fractional settings, which was not very helpful to them in terms of working toward CDA. However, these three sessions revealed the importance of understanding the relationship between divisor, fractional part of the quotient and remainder.

The sessions 6, 7, and 8 were about development of a solid understanding of remainder in whole number setting, moving to fractional setting and the abstraction of the relationship between divisor, quotient, and remainder by developing a sense for divisor as an intensive quantity (items/group) that connects the two extensive quantities (items, groups), dividend and divisor. These sessions used a similar format as the others but this time participants' attention was directed toward two different but related ways to interpret the results of division word problems: results only having quotient, results having whole number part of quotient and remainder. In doing so, I had the participants initially start working on contextual problems and then move to context-free problems because of the importance of realistic situations in developing mathematical concepts (Sharp & Adams, 2002; Streefland, 1991; Perlwitz, 2004). At the end of session 8, the participants had a solid understanding of division of fractions (as abstraction of quotitive situations), a sound understanding of a difference between partitive and quotitive division in fractional settings, and a solid understanding of remainder in both whole number and fractional settings.

As a result, upon entering the algorithm sessions (sessions 9 and 10), participants already had the abstraction that division of fractions means an investigation of the number of one quantity within another. They also had the notion that division is a multiplicative comparison of two quantities to get a third one. In addition, they abstracted the idea that there is a network of multiplicative relationships among the divisor, remainder, and quotient. They also had an abstraction of the role and meaning of equivalent fractions, referents (the dividend refers to the quantity at hand, divisor means quantity per group and quotient refers to number of groups) and coordination of referents. They went into sessions 9 and 10 with all of these abstractions.

Tasks for Teaching Sessions 9 and 10 with their Conceptual Analyses

The tasks given to the participants during the last two sessions were based on context-free problems. The problems consisted of division of fractions for which the denominators of the fractions were relatively prime numbers (see Figure 1).

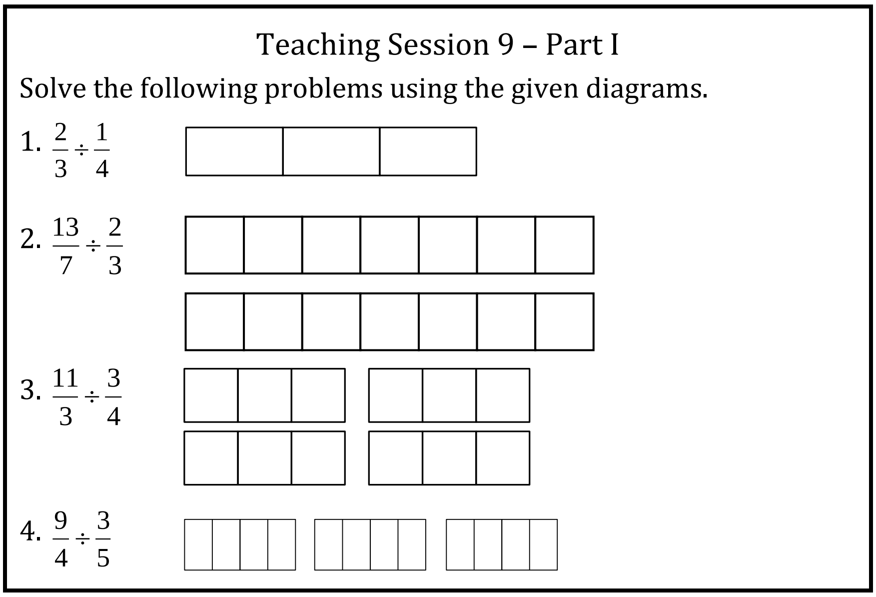


Figure 1. Illustration of tasks for Teaching Session 9 – Part I.

The purpose in doing so was to help participants not to get distracted by irrelevant solution strategies (e.g., partitioning the quantities vertically versus horizontally) and by some intermediate steps that would hamper the developmental process.

In the last two sessions, the main purpose was to have participants abstract CDA and then investigate the development of such an abstraction. Therefore, Teaching Session 9 and 10 served the purpose of helping the participants coordinate the understandings mentioned above in such a way that they would develop an algorithm based on their activities.

Teaching Session 9 - Part II

For the following problems, do not draw diagrams. Instead, write down in words each step that you would do if you were to draw diagrams.

Problem 1: $\frac{7}{2} \div \frac{2}{3}$	
Steps You Would Take	*Results of Those Steps*
1.	

Problem 2: $\frac{5}{8} \div \frac{2}{7}$	
Steps You Would Take	Results of Those Steps
1.	

Problem 3: $\frac{14}{15} \div \frac{3}{8}$	
Steps You Would Take	Results of Those Steps
1.	

Figure 2. An illustration of tasks for Teaching Session 9 – Part II.

Problems of Part II in Teaching Session 9 (see Figure 2) included the same activity sequence as in Part I but this time the participants were not to solve the given problems using physical drawings. Instead, they need to solve them mentally benefiting from mental diagram work. The fractions used in each question were bigger and messier than the ones used in previous ones. The purpose for not allowing participants to solve the problems with physical drawings was to help them mentally reflect on the activity sequence they had and move them toward an algorithmic thinking about the sequence.

For each problem, the participants were to think about every step they would go through to solve the problems, as if they were using diagrams, and the results of each step. In this way, they were to think about what should be drawn first and then to note the corresponding result of that action, and continue in that manner. Meanwhile, they were not allowed to physically draw any diagram or use any formulae. This way of operating was important in order to help participants develop an anticipation of the activities they would go through and the associated results. Helping them develop such anticipation was thought to be useful. That is, helping participants reflectively think about the activity sequence and associated results and make an abstraction would be possible.

As the fractional quantities got bigger and messier, the participants were encouraged to think about how their activities affected the size of the dividend and divisor, and the overall goal. They were to learn two things in this process: (1) knowing that common denominator results in same size units for divisor and dividend; (2) knowing that when the dividend and divisor are based on same size partitions, quantifying the number of partitions (that make up the divisor) within the dividend is same as dividing the numerators.

Teaching Session 10 – Part I

Problem 1	$\frac{3}{2} \div \frac{2}{5}$	What is the goal in this question?	What needs to be done?	For what purpose?
	STEP 1 STEP 2 ...	...	...	...
Problem 2	$\frac{8}{3} \div \frac{3}{4}$	What is the goal in this question?	What needs to be done?	For what purpose?
	STEP 1 STEP 2 ...	...	...	...
Problem 3	$\frac{22}{5} \div \frac{2}{3}$	What is the goal in this question?	What needs to be done?	For what purpose?
	STEP 1 STEP 2 ...	...	...	...

Figure 3. An illustration of tasks for Teaching Session 10 – Part I.

Teaching Session 10 consisted of Part I and Part II: three initial problems in Part I, followed by another similar three in Part II. For Part I, similar to the previous session, participants were asked to think about the steps they would take if they were using diagrams mentally in solving the given fraction division problems. In solving the problems, they were to answer several questions as illustrated in Figure 3. For each step, they were to identify the specific goal, the action to be taken and the purpose of that action. If the change in the type of the quantities affected the goal, they needed to restate the goal in the appropriate column. For example, when the common denominator for the given fractions was found, the initial overall goal, finding for example number of 2/5 within 3/2, was to be changed to "finding the number of 4/10 within 15/10." The purpose for following such a method was to encourage them to think about why they were doing what they were doing rather than having them go through additional similar type problems. In addition, in the previous session, they were changing their goals by basing their discussion on the numeric results (by unitizing the dividend and divisor) without paying attention to the nature of that change in goals. Such structuring of the questions was to help them reflectively think about the change in the overall goal and its affects in the solution process.

Note that Part II of Teaching Session 10 was similar to Part I except that the given fractions required messy calculations (e.g., [21/38]÷[7/98]). Since participants made the necessary abstractions for CDA once they completed Part I, there was no need to apply Part II and therefore, it was skipped. Thus, Part II is not included in this paper.

Throughout Teaching Session 10 the participants were allowed to use calculators to find the result of messy calculations once they talked about what they need to do.

Therefore, even though the numbers get messier for each subsequent question, because of calculator use, they were not to deal with the calculations but the methods they would employ to find the results. In this way, the participants also had the opportunity to reflect on the meaning of the activities in the activity sequence they were going through.

Data Analysis Procedure

Analysis of the abstractions participants had prior to last two teaching sessions, the retrospective analyses of the last two teaching sessions and analysis of the post-interviews helped me characterize conceptual advances of the participants. The reason for mostly drawing on the analyses of the last two teaching sessions for this paper is because they are specifically related to the development of CDA.

In analyzing the data, I initially identified parts where the participants did not have a certain understanding and then I located the places where they had that understanding. Then, benefiting from the aforesaid theoretical constructs (e.g., goal setting, activity, activity sequence etc.), I explained the learning trajectory of the participants by using evidence throughout the data. I also investigated the reasons for such shifts in understanding. In explicating on the learning of participants, I identified places where the participants only focused on the numeric aspects of the given tasks and where they reflectively abstracted concepts as well as the nature of shifts in between.

In doing so, I constantly tried to formulate hypotheses about the participants' evolving understandings and made claims, and tried to support those with the data at hand. The ones for which I was able to provide considerable support were then stated as claims. Once the claims were made, I also looked for counter evidence for such claims. When a hypothesis was generated or a claim made, I searched throughout all the data to check to see whether there was contradictory evidence. Finally, using the collection of claims I had, I organized them to help model the participants' evolving understandings pertinent to CDA. Throughout this process all these categories and claims were discussed with a PhD mathematics educator and continuously reviewed and revised.

Results

Participants' Work with a Particular Activity Sequence in Session 9

To help the participants develop a sense for the CDA and how it functions, they were given four context-free problems in teaching session 9 as illustrated in Figure 1. They had gone through the similar sequence previously but this time the main focus of the session was on the given task sequence to develop an algorithm. The participants solved all four problems using very similar solution processes without any difficulty in about ten minutes. Both participants initially solved the problems alone and then one of them explained her solution on the board with a follow-up discussion. What follows is one example [for (9/4)÷(3/5)] to exhibit participants' approaches and their thinking processes about the mathematical relationships hidden in the problems.

> W: [*drawing three rectangles and partitioning each into four pieces vertically as in Figure 4.1*] Okay, so we have our dividend. I am not using these three [*pointing to the shaded three pieces in Figure 4.1*] because we only have nine fourths [*pointing to unshaded parts in Figure 4.1*]. And another [*partitioning each whole rectangle into five pieces*

horizontally as in Figure 4.2]. Okay. So I divided [*each whole rectangle*] into fifths because we want to know how many three fifths are in nine fourths. So, um, since these are fifths [*pointing to horizontal sections in the first rectangle of Figure 4.2*], we want to count by three fifths so here is one thing of three fifths [*circling the upper three rows of the first rectangle as in Figure 4.3*] -

R: Uh huh.

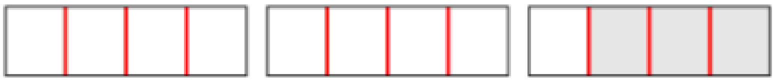


Figure 4.1

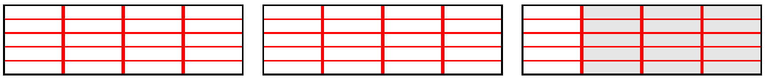


Figure 4.2

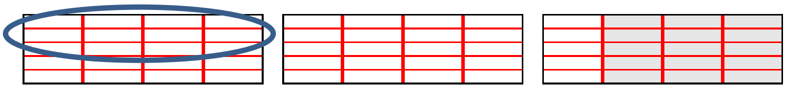


Figure 4.3

Figure 4. Representation of participants' drawings for (9/4)÷(3/5).

W: And here is two things of three fifths [*marking the bottom two row of the first rectangle together with the utmost row of the second rectangle*], and here is three things of three-fifths [*circling the second, third and fourth row of the second rectangle together*] and we don't have enough so there is three [*referring to 3 circled divisor groups*]. And we don't have enough to make, um, another three-fifths so in three fifths, there is twelve of these little things [*pointing to the pieces of the size 1/20 in the first marked 3/5-group*]. And we only have nine [*pieces of the size 1/20 unmarked*], so there is nine twelfths of another three-fifths left. And -

R: What's the? Okay and what?

W: And, um, why divide like something into twelfths when you can have it simpler [*referring to 9/12 and its simpler form 3/4*] so there is three, it could be three [*and*] three fourths instead [*considering the answer as 3-and-3/4*].

As seen in the above episode, Wanda set her goal as to find the number of three fifths within nine fourths. The analysis illustrating the activities and the corresponding results Wanda (and also Nancy) generated to reach that goal in this problem and in all other problems of Part I of Teaching Session 9 was given in Table 1.

Because of their appropriate choice in referents and their accurateness in referring to the important multiplicative relationships (between the divisor and quotient, and remainder and fractional part of the quotient), the participants followed this activity sequence and attended to the associated results without any trouble. In addition, this sequence was similar to their previous experiences in the prior sessions but here the focus was to be on developing an algorithm, which will be further investigated in the following sections.

When the participants had doubt about the parts of their activity sequence, they either reminded themselves about the overall goal for the problem (looking for number of a within *b* for a problem like *a*÷*b*) or they checked the referents for dividend, divisor, and quotient to decide on what to focus on. Such adjustments within the task sequence helped them organize their thinking in approaching the given problems more appropriately.

Table 1. Participants' activity sequence for Part I of Teaching Session 9.

Mental/Physical Activities	*Corresponding Results*
(1) Draw unit wholes (as rectangles), partition them, and shade out the necessary (vertical) partitions to identify dividend	Diagrammatic representation of dividend
(2) Partition horizontally each unit whole to allow for marking divisor-size groups	Diagrammatic representation of divisor
(3) Unitize divisor and/or dividend according to the new partitioning	Diagrammatic representation of the unitized dividend and divisor that have same denominators
(4) Identify full divisor groups within dividend by either numbering partitions that makes up a group with the same numeral, or by grouping the partitions first and numbering each group as a single whole	Numeric result of whole number part of quotient
(5) When there is not enough partitions to make another divisor group, multiplicatively compare the number of remainder partitions with the number of partitions that make up a divisor group	Numeric result of fractional part of the quotient
(6) Identify quotient using the results of activity 5 and activity 4	Numeric result of quotient

Note that even though Wanda and Nancy followed such an activity sequence, we cannot assume that they reflectively think about their sequence in the course of solving the problems. Therefore, the second part of Teaching Session 9 was given to have them consciously reflect on that sequence.

Developing the CDA

Once the participants solved the first problem of Part II in Teaching Session 9 (see Figure 2), I asked them to tell me what they wrote for each activity and the corresponding result, and then I was only drawing what they directed me to draw on the board without any interruption. After the first problem, the discussion was about the activities and the corresponding results without going into the actual drawings. Their solutions consisted of two-way partitioning (horizontal and vertical partitioning of the wholes making up the dividend) and they paid considerable mental attention to the referent units and the involved multiplicative relationships among the divisor, dividend, and quotient (e.g., quotient refers to the number of divisors within dividend).

Participants were able to anticipate the results of the hypothetical activities to be taken in representational world without physically working in that environment. For example, for problem 3 of Part II [(14/15)÷(3/8)], the participants explained what steps to take and the corresponding results appropriately. In this section, the sentences within the quotations are actual wordings of the participants. Since the participants either accepted or explained the rationale of each other's actions, I used the pronoun "they" instead of individual names in this section.

They first identified their overall goal as figuring out the number of 3/8 in 14/15. They then indicated that they should "draw a whole […] then divide the whole into fifteen equal parts vertically, […] shaded out one fifteenth" to get the dividend, 14/15. They then pointed out that they needed to "divide the whole into eighths horizontally" which results in 120/120. In this new diagram, 14/15, the dividend, becomes 112/120 and the 3/8 becomes 45/120. Then, using the 3/8 (i.e., 45/120) as a unit, they stated they will, in fact, be "count[ing] the number of one hundred twentieths in three eighths," so they were set to "mark off every 45/120 in 112/120."

Here, there is a shift in their initially set goal. Their overall goal was to find number of 3/8 in 14/15 but now it takes the form of finding number of 45/120 within 112/120. This adjustment in the fractions and in the overall goal was enabled by unitizing both quantities of 3/8 and 14/15 in terms of 1/120ths – in other words, they made the denominators common. This also helped them unconsciously turn their initially set overall goal into the goal of finding number of 45/120 in 112/120. This shift in the overall goal was natural for the participants since they were only focusing on the numeric aspects of the problem as opposed to reflectively thinking about the activity sequence they were going through. Otherwise, they could have figured out the algorithm at this point.

Once they had the unitized dividend and divisor, they started counting the number of 45/120 in 112/120. Perhaps, by benefiting from the numeric relationship between 45 and 112, they realized that there were two-whole 45/120 in 112/120 with a remainder of 22/120. They then interpreted 22/120 as 22/45 of another whole group of the size 45/120 by multiplicatively comparing 22/120 to 45/120. That is, they measured 45/120 by using 22/120. This measurement resulted in 22/45. As a result, they announced the quotient as "2 and 22/45."

As seen in this solution method, even though the numbers were increased, the participants were still able to think mentally about the activity sequence they had (see Table 1) and the associated results (see Table 1), and applied it efficiently to the question of (14/15)÷(3/8). However, they were still working numerically and not attempting to think about ways to consider the problems with an algorithm.

At times, when the participants thought they were having difficulty, they reminded themselves about the overall goal for the problem and refocused themselves on the solution process. However, they were able to execute the activity sequence they already had mechanically. In addition, they did not reflect on the parts of the activity sequence to formulate a way to think about the fraction division problems more efficiently since they did not have an abstraction of the CDA yet. This was also because they were only solving problems having dividend and divisor with relatively prime denominators. The Teaching Session 9 ended at this point.

Abstracting the Numeric Aspects of the Algorithm

Previously, they went through certain activities but they did not question the rationale for those activities without my prompts. The task sequence given in Part I of Teaching Session

10 was intended to have them reflect on those rationales for their actions. What follows is an example of how they went through Problem 2, (8/3)÷(3/4). Note that the sentences given within quotations are what participants said during the session. They initially identified their overall goal as "How many three fourths are in eight thirds?" and mentioned that they needed to "draw three wholes and divide [each] into thirds. […] shade out one third […] to get 8/3." At this point, they knew that "you still have the same goal." After restating their goal, they continued as "split them into fourths horizontally […] to make groups of three fourths." Now, their overall goal was changed to "find the number of nine twelfths in thirty two twelfths" for which they needed to "group together nine twelfths as many times as possible."

This description suggests that the participants went through certain mental activities as follows:

1. They initially identified the dividend (drawing enough rectangles, partitioning them, and marking enough of them to identify dividend);
2. They identified the divisor (repartitioning the dividend and grouping enough partitions within the dividend to identify divisor);
3. They counted the number of divisors within the dividend (grouping a number of partitions that make a full divisor group, counting such full groups), and if there was a remainder, they made a multiplicative comparison between the divisor and leftover by measuring the leftover with the divisor;
4. Finally they noted the result of that comparison as the fractional part of the quotient.

Once they identified the dividend and then the divisor by unitizing the dividend, they actually found the common denominator of the divisor and the dividend. When they counted the number of divisor groups (certain number of partition groups) within the dividend (total number of partitions in dividend), they actually counted a number of partitions within total number of partitions, which was same as dividing the numerators of the dividend and divisor. However, they did not seem to pay enough attention to these facts yet.

As they went through this sequence, they began to see some numeric pattern among the results. By looking at (8/3)÷(3/4) and (32/12)÷(9/12), Nancy mentioned

> N: Well, I don't know if it is just coincidence but it's thirty two over nine [*referring to the result, 32/9*] and there is a thirty two, like you can cross out the twelfths and then there would be thirty two divided by nine.

When encouraged to think about what it means to "cross out those twelfths," Nancy's response was

> N: Well, since you are both being divided by the same thing, can you just divide them by each other?

whereas Wanda confirms "it works." This realization was based on their attention to the numeric patterns among the results of their activities since they also agreed that they did not know why there would be such numerical pattern. The rule they used, at this point, consisted of finding the common denominators and canceling out those common denominators. They derived this rule from the numerical pattern by comparing the numeric results of the activities they went through for several problems, but they did not know the rationale for such a rule yet.

For Problem-3 of Part I of Teaching Session 10, (22/5)÷(2/3), they went through a similar activity sequence and generated a result mentally. When they were asked about the reason for changing the nature of dividend and divisor (through unitizing), they reasoned as in the following episode:

> N: So you are working with the same like the wholes that are divided into same number of parts.
>
> W: Hmm hmm.
>
> R: Like in this case, fifteenths?
>
> N: Yeah. Instead of working with fifths and thirds.
>
> R: So this [*pointing to 66/15*] tells us what?
>
> N: That tells us what twenty-two fifths [*is*].
>
> R: Twenty-two fifths and two thirds [*writing 2/3 next to 10/15 on the board*]. Why didn't we focus on these [*pointing to 2/3 and 22/5 in (22/5)÷(2/3)*] and moved to here [*pointing to 66/15 and 10/15*]?
>
> W: What she said.
>
> N: Because there, it was just hard to figure out like equate thirds and fifths together.

The above episode suggests that they seemed to understand the rationale for finding the common denominators as generating same size units on which the divisor and dividend were based. This understanding seems to be resulted from their reflection on the change in units and the unitizing process for the initial dividend and divisor. This is not to say that they did not know the rationale for equivalent fractions previously. Instead, they were beginning to pay attention to the shift from one form of dividing fractions, (22/5)÷(2/3), to another, (66/15)÷(10/15), and reflecting on that shift. And this shift became meaningful by calling on their understanding of the equivalent fractions. Hence, they became more conscientious about the role of unitizing in dividing fractions.

Focusing on the Rationale for the Explored Numeric Pattern

When the participants went through the individual activities and the results of those, the numerical values they encountered for the divisor and dividend seemed to have the same denominators. They realized that the denominators of both quantities were being equated numerically.

As illustrated in the last episode, it was coming together for Nancy as she made some reflection on the activities and the results associated with those. She came to realize that the comparison between 22/5 and 2/3 was not as easy as the comparison between 66/15 and 10/15. In one case, there was no common ground to compare the two fractions whereas in the other case there was a common denominator. In the first case, identification of the multiplicative relationship between dividend and divisor was almost impossible in a diagrammatic approach whereas in the latter case it was easier for them to think about the involved multiplicative relationships among divisor, dividend, and quotient. When I asked them about the relation between 66/15 and 22/5 in a diagrammatic environment, Nancy reacted as,

N: Well, you divided the twenty two fifths into thirds, so there are three times as many pieces. […] we have five fifths but you divide each fifth into three parts. […] and so the fifths, you have fifteen and so that twenty two pieces, we have sixty six pieces. But because both of them stay the same, I mean.

Wanda also supported this argument. In this setting, participants realized that repartitioning an already partitioned quantity such as 22/5 by a certain factor (e.g., 3) requires a relative proportional increase between numerator and denominator. Their call on equivalent fractions was important since it was the basis for understanding the rationale for finding a common denominator. This realization on participants' part seemed to be because of their attention to and reflection on the purpose of changing the form of the dividend and divisor by keeping the sizes constant. Prior to such attention provided to them in the task sequence in Figure 3, they were just mechanically going through the activity sequence without reflecting on the pieces of it and the role of equivalent fractions. However, with my prompt, they were encouraged to reflect on the rationale for adjusting the given quantities and adjusting the overall goal. The next step for participants was to develop an understanding of the second part of the algorithm: dividing the numerators.

Making Sense of Dividing the Numerators

Nancy and Wanda observed that dividing the new equivalent forms of dividend by divisor would give the same result as dividing the numerators if the denominators were same. They initially were thinking about a canceling method with which they had familiarity from probably their early schooling. However, I encouraged them to think back to their diagram activity so they could abstract an understanding of why this relationship existed.

R: Why are we dividing sixty six by ten? You are saying we are canceling these out, how does it appear in the diagram?

W: I don't know. We kind of know we are working in fifteenths so.

R: Okay, you are working with fifteenths but why would you divide sixty six by ten?

N: Well, because there are sixty six total pieces that we're working with. And we are grouping ten pieces together.

W: As many times as we can. [*Nancy repeats what Wanda said*]

R: Okay. How is it related to sixty six divided by ten?

N: Because that would be the same thing as dividing sixty six by ten.

R: What does sixty six divided by ten tell us?

W: It says how many groups of ten are in sixty six.

R: Okay [*writing what Wanda said on the board*].

[…]

N: Like everything is in fifteenths. Like both when we look at sixty six, it's sixty six fifteenths in the whole thing. And we want groups of tens, ten fifteenths, so.

R: So you are trying to figure out number of ten fifteenths in sixty-six fifteenths, which is same as -

N: How many tens are in sixty six.

Based on the diagrammatic representation of grouping 10/15 partition within 66/15, they seemed to think that the actions both divisions required were the same. In each case, there was a grouping action of ten pieces. And therefore, they thought that both divisions resulted in the same answer. They considered the denominator as the common size of the pieces. The question of "How is (66/15)÷(10/15) related to 66÷10?" encouraged them to think about the relationship between those two expressions. But then, since they were working with same size pieces, this realization led them to think about the process for both division cases as investigating the number of 10 objects within 66 objects of the same size. The diagram in a sense was hiding this fact since they were counting 10-piece groups within 66 pieces. In doing so, the size of each piece (1/15) was being hid by the diagram unless questioned. However, their focus on the relation between the use of common size pieces (1/15) and the nature of grouping activity within diagrammatic work (10-piece groups within 66 pieces) helped them reflect on what was being hid behind the diagrammatic representation (looking for 10-piece groups within 66 pieces is same as looking for number of 10/15 within 66/15). Their fluency in solving the subsequent problem, (23/24)÷(3/7), also suggested that they abstracted the rationale for dividing fractions. The subsequent problem was (23/24)÷(3/7) and they needed to solve it mentally by identifying the activities they would go through with the associated results, and they did it successfully.

Above examples of participants' work from the last teaching session suggests that once they explained their activities and the results they would get from those activities, they mainly pointed to two outcomes: finding the common denominators and dividing the numerators. This realization came from their treatment of the activities to generate dividend and divisor as single entities. They knew that their initial goal was to determine dividend even though it might include several steps to reach that goal. The next goal for them was to identify the divisor even though it might mean a new set of activities. Once the dividend and divisor were determined this way, their new goal, which was an adjustment of the old one, was to identify the multiplicative relationship between the unitized divisor and unitized dividend. However, this time such identification was easier since both quantities were based on same size partitions. The partitioning they did so far to figure out divisor and dividend resulted in two quantities of the same type to be multiplicatively compared. At this point, they abstracted the relationship that the identification process was about simplifying the multiplicative comparison between the given two quantities (divisor and dividend). They also had dividend and divisor as two single entities to be compared. And the problem at this point was to make sense of that multiplicative comparison. Conceptualizing the divisor and dividend as single entities led them to abstract the multiplicative relationship between those two quantities as manifestations of finding one object (of a certain size) within another object (of the same size), which was about division of numerators. The last teaching session ended at this point.

The Participants' Understanding of CDA as seen in Post-Interviews

The results of post-interviews also showed that Wanda and Nancy had an abstraction of the algorithm and its fundamental pieces. Even though the post interviews were conducted three weeks after the teaching sessions ended, the participants seemed to hold the necessary understandings required for articulating the meaning and functioning of CDA. During the post-interview, the participants were asked a question that consisted of an algorithm for a specific example as follows:

Question: Mary claimed that to divide two fractions, you change all mixed numbers into improper fractions, find common denominators, and then divide the numerators. For example, (3 $^{4/5}$)÷(2/3)=(19/5)÷(2/3)=(57/15)÷(10/15)=57/10=(5 $^{7/10}$). Will this method always work?

In order to answer such a question, they needed to know that there was a reduction of fractional division to the whole number division. And they needed to know that this reduction was possible by making both the divisor and dividend quantities having same units.

Wanda was aware that the first part of the algorithm was about equivalent fractions and she explained it as:

> W: Because nineteen fifths and three and four fifths. Although they are in different forms, they still represent the same amount of something. […] And since those represent the same amount, you need to put them in like the same proportion so that you can see them like side by side as equal things. So […] finding the common denominator would do that.

For Wanda, the reason for finding the common denominators was to "compare the quantities because we know that they are the same size pieces." As seen through her wording, she referred back to her equivalent fractions understanding. In a sense, she was also referring back to the diagrammatic approach she would use for such a division problem. In this way, she knew that finding equivalent form of a fractional quantity did not affect the size of the quantity at all. In this manner, to Wanda, it was possible to turn the given dividend and divisor into improper fraction mode. And since the goal for the division problem stayed the same, this change would not affect the result. She also seemed to be aware that she needed to make a multiplicative comparison between the two quantities, and the comparison could easily be done when the involved quantities are based on the same size fractional units.

Nancy's reaction was not much different from Wanda's in interpreting the common denominator step:

> N: […] if you look at the same whole, fifths are smaller than thirds. So you can't really compare fifths and thirds. But fifteenths, I mean if you find the common denominator so you do change the numerators but they remain equivalent, like the new numerators here, they are equivalent to the prior fractions but now you have the same base. So the fifteenths are the same size as these fifteenths. So you don't even really have to worry

> about the size of them, just the number of things that are being divided. Like, the fifty seven divided by ten.

Here, Nancy referred to the fact that changing the number of partitions proportionally for a fraction did not affect the size of the fraction.

When the issue was to explain the rationale for the second part of the algorithm, Wanda based her rationale for dividing the numerators on the fact that she used the same size pieces. Wanda seems to think about her diagrammatic approach and about the activities that she would go through for such a step. Since she already identified the dividend and divisor, she seemed to know that the division 57÷10 was conceptually and procedurally same as the division (57/15)÷(10/15). In addition to Wanda, Nancy also pursued a similar reasoning to make sense of the division of numerators, the second part of the algorithm.

As a result, their answers to the post-interview tasks showed that the participants had an understanding of the common denominator algorithm and were able to provide the rationale for each step of the algorithm. They stated that having a common ground for both given fractional quantities was a way to reduce the complexity in the given fraction division problems. They also knew that in this way, one could think about the quantities (divisor and dividend) as objects of a certain size. And, as long as the size of the objects matched with each other, they would think about the investigation of number of one object within another in different ways ("number of 2/3 in 3-and-4/5" ≡ "number of 10/15 in 57/15" ≡ "number of 10 in 57"). In this sense, the appearance of the object did not affect the overall goal and functioning of the operation for the problem.

Discussion and Conclusions

The current study contributed to the current mathematics education literature by analyzing the learning of two prospective elementary teachers as being an illustration of how to realize the conceptual affordances provided by CDA. This is further explained below.

Conceptual Affordances Provided by CDA: The process of developing CDA consists of several developmental steps that are based on learners' activities that they held before the instruction. First, it requires a multiplicative comparison between the given two quantities. To do such a comparison there needs to be a simplification of the given quantities if they are not easily comparable to each other. This simplification process is based on identifying the given quantities and unitizing them to make them refer to the same referents (by referring to understanding of equivalent fractions) so that they can be easily multiplicatively comparable. This type of unitizing results in the modification of the initially set overall goal. If the initial given problem is (3/4)÷(3/7), for example, then after simplification process one gets (21/28)÷(12/28) which leads one to modify the initial goal according to these newly unitized quantities as: "How many 12/28 are in 21/28?" which is same as, "How many 3/7 are in 3/4?" Modification of the overall goal sheds light on the multiplicative comparison to be done between the unitized divisor and dividend. Here, one other developmental step is that the multiplicative comparison between 21/28 and 12/28 is the same as the one between the numerators 21 and 12 since both comparisons are based on the same overall goal of finding number of 12-partition groups in 21-partition (same size) groups. Use of diagrams in this sense reduces the division on fractional dimension to division on whole numbers dimension. The result of such realization takes care of developing a sense for the second part of CDA, dividing the numerators. Since the investigation of 12/28 within 21/28 is based on same size fractional units (1/28), the same investigation can be considered when looking for 12 units within 21 units of the same size. In other words, it requires one to think about both fractional quantities as objects to be compared multiplicatively.

As a result, the CDA has a conceptual basis depending on basic operations of partitioning, unitizing, and counting, which makes it more inventible by participants since these operations are already available to them. CDA differs from IMA in this manner. Also, when participants are encouraged to construct this algorithm based on their work with diagrams, CDA formalizes the work that participants do with diagrams. In working with diagrams, learners need to go through a well-articulated activity sequence that they could refer to, whenever needed. Reflecting on the purpose of each activity in the activity sequence is essential for reflective abstraction. Otherwise, one only thinks about generating ways to think about the transition between different steps as opposed to reflective abstraction. Therefore, it is important for the learner to keep in mind the goal of each step and make a comparison based on the tri-set: goal-activity-result. This kind of reflection results in thinking about the algorithm independently of its numeric base.

Fostering the Development of CDA: The development of CDA consisted of two sub-steps. The first one was to help the participants develop an understanding of the rationale for using same size units to multiplicatively compare two given fractional quantities. Then the next step was to help them develop an understanding of the idea that dividing two fractional quantities had the same structure as dividing numerators of those two quantities as long as the quantities were all based on the same size partitions. The reason for choosing this algorithm was that it represented the activity participants pursued in diagrammatic setting. In going through the activity sequence that they had, there was not too much curtailment and CDA was inventible based on participants' activity. This is consistent with J. Gregg and D. Gregg's (2007) finding about accessibility of CDA with measurement interpretation of division.

To help participants develop these two sub-steps for an algorithm, the designed task sequence engaged them in mentally solving the given division of fractions problems as if they were using diagrams. This type of work helped them come to a point where they anticipated what to do next and focus on what to pay attention to. In this way, they were encouraged to think about their thought processes to make an abstraction. By going through the activity sequence they already had from the previous sessions, in light of diagram use, they were also encouraged to think about the reason as to why the given fractional quantities transformed into another form for which understanding of equivalent fractions plays an important role. In this way, they realized that the purpose was to have equal size partitions so that the multiplicative comparison between the divisor and the dividend was easily identifiable. Then, based on their diagram work, they realized that they were counting a certain number of partitions within some total number of partitions, which was equivalent to thinking about dividing the numerators of the fractional quantities at hand.

Acknowledgements

The data provided here is adopted from (Zembat, 2004) and repurposed to serve the retrospective analysis provided for this study.

● ● ●

References

Armstrong, B. E., & Bezuk, N. (1995). Multiplication and division of fractions: The search for meaning. In J. Sowder & B. P. Schappelle (Eds.), *Providing a foundation for teaching mathematics in the middle grades* (pp. 85-119). Albany, NY: State University of New York Press.

Ball, D. L. (1990). Prospective elementary and secondary teachers' understanding of division. *Journal for Research in Mathematics Education, 21*(2), 132-144.

Borko, H., Eisenhart, M., Brown, C. A., Underhill, R. G., Jones, D., & Agard, P. C. (1992). Learning to teach hard mathematics: Do novice teachers and their instructors give up too easily*? Journal for Research in Mathematics Education, 23*(3), 194-222.

Contreras, J. N. (1997). Learning to teach algebraic division for understanding: A comparison and contrast between two experienced teachers. In J. A. Dossey, J. O. Swafford, M. Parmantie & A. E. Dossey (Eds.), *Proceedings of the 19th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (Vol. 1, pp. 535-544). Bloomington-Normal, IL: Eric Clearinghouse for Science, Mathematics, and Environmental Education.

Gregg, J., & Gregg, D. U. (2007). Interpreting the standard division algorithm in a `Candy Factory` context. *Teaching Children Mathematics, 14*(1) 25-31.

Kieren, T. E. (1993). Rational and fractional numbers: From quotient fields to recursive understanding. In T. P. Carpenter, E. Fennema & T. A. Romberg (Eds.), *Rational numbers: An integration of research* (pp. 49-84). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Lamon, S. (1996). The development of unitizing: Its role in children's partitioning strategies. *Journal for Research in Mathematics Education, 27*(2), 170-193.

Li, Y. & Kulm, G. (2008). Knowledge and confidence of pre-service mathematics teachers: The case of fraction division. *ZDM – The International Journal on Mathematics Education, 40*(5), 833-843.

Ma, L. (1999). *Knowing and teaching elementary mathematics: Teachers' understanding of fundamental mathematics in China and the United States.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Perlwitz, M. D. (2004). Two students' constructed strategies to divide fractions. *Mathematics Teaching in the Middle School, 10*(3), 122-126.

Piaget, J. (1964). Cognitive development in children: Piaget - development and learning. *Journal of Research in Science Teaching, 2*, 176-186.

Piaget, J. (1971). *Biology and knowledge.* Chicago: The University of Chicago.

Piaget, J. (1983). Piaget's theory. In W. Kesson (Ed.), *History, theory, and methods, Handbook of child psychology* (Vol. 1, pp. 103-128). New York: John Wiley & Sons.

Piaget, J. (2001). *Studies in reflecting abstraction* (Trans. R. L. Campbell). Sussex, England: Psychology Press.

Post, T. R., Harel, G., Behr, M. J., & Lesh, R. A. (1991). Intermediate teachers' knowledge of rational number concepts. In E. Fennema, T. P. Carpenter & S. J. Lamon (Eds.), *Integrating research on teaching and learning mathematics* (pp. 177-198). Albany, NY: State University of New York Press.

Sharp, J., & Adams, B. (2002). Children's constructions of knowledge for fraction division after solving realistic problems. *The Journal of Educational Research, 95*(6), 333-347.

Simon, M. A. (1993). Prospective elementary teachers' knowledge of division. *Journal for Research in Mathematics Education, 24*(3), 233-254.

Simon, M. A., Saldanha, L., McClintock, E., Akar, G. K., Watanabe, T., & Zembat, I. O. (2010). A developing approach to studying students' learning through their mathematical activity. *Cognition and Instruction, 28*(1), 70-112.

Simon, M. A., Tzur, R., Heinz, K., & Kinzel, M. (2004). Explicating a mechanism for conceptual learning: Elaborating the construct of reflective abstraction. *Journal for Research in Mathematics Education, 35*(5), 305-329.

Sowder, J. T. (1995). Instructing for rational number sense. In J. T. Sowder & B. P. Schappelle (Eds.), *Providing a foundation for teaching mathematics in the middle grades* (pp. 15-30). Albany, NY: State University of New York Press.

Sowder, J. T., Philipp, R. A., Armstrong, B. E., & Schappelle, B. P. (1998). *Middle-grade teachers' mathematical knowledge and its relationship to instruction: A research monograph.* Albany, NY: State University of New York Press.

Steffe, L. P. (1991). The constructivist teaching experiment: Illustrations and implications. In E. von Glasersfeld (Ed.), *Radical constructivism in mathematics education* (pp. 177-194). Dordrecth, The Netherlands: Kluwer Academic Publishers.

Steffe, L. P., & Thompson, P. W. (2000). Teaching experiment methodology: underlying principles and essential elements. In A. E. Kelly & R. A. Lesh (Eds.), *Handbook of research design in mathematics and science education* (pp. 267-306). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Streefland, L. (1991). *Fractions in realistic mathematics education.* Dordrecht / Boston / London: Kluwer.

Thompson, P. W. (1993). Quantitative reasoning, complexity, and additive structures. *Educational Studies in Mathematics, 25*(3), 165-208.

Tzur, R., & Timmerman, M. (1997). Why do we invert and multiply? Elementary teachers' struggle to conceptualize division of fractions. In J. A. Dossey, J. O. Swafford, M. Parmantie & A. E. Dossey (Eds.), *Proceedings of the 19th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (Vol. 2, pp. 553-559). Bloomington-Normal, IL: Eric Clearinghouse for Science, Mathematics, and Environmental Education.

Usiskin, Z. (2007). Some thoughts about fractions. *Mathematics Teaching in the Middle School, 12*(7), 370-373.

Zembat, I. O. (2004). *Conceptual development of prospective elementary teachers: The case of division of fractions* (Doctoral dissertation, The Pennsylvania State University). ProQuest Digital Dissertations Database. (Publication No. AAT 3148695)

Zembat, I. O. (2007). Sorun aynı – kavramlar; Kitle aynı - öğretmen adayları. *İlköğretim Online, 6*(2), 305-312.

www.iejee.com

This page is intentionally left blank

International Electronic Journal of Elementary Education, 2015, 7(3), 423-440.

Assessing Preschool Teachers' Practices to Promote Self-Regulated Learning *

Fahretdin Hasan ADAGİDELİ **
Istanbul University, Turkey

Seda SARAÇ
Institute of Creativity, Turkey

Engin ADER
Boğaziçi University, Turkey

Received: 13 March,2015 / Revised: 1 May 2015 / Accepted: 27 May 2015

Abstract

Recent research reveals that in preschool years, through pedagogical interventions, preschool teachers can and should promote self-regulated learning. The main aim of this study is to develop a self-report instrument to assess preschool teachers' practices to promote self-regulated learning. A pool of 50 items was recruited through literature review. Items, then, were formulated as statements, to which the teachers could respond on a Likert-scale. In line with the expert and teacher opinions, twenty statements were removed from the original pool and some statements were reformulated. The latest version of the scale consisted of 21 statements. The participants were preschool teacher (N=169) from Istanbul. Empirical testing at item and scale level showed that T-SRL is a reliable and a valid instrument to assess preschool teachers' classroom practices promoting self-regulated learning of their children at the age of 3-6.

Keywords: Self-regulated learning, teacher practices, preschool education.

Introduction

Today's rapidly changing societies with the emerging new forms of socialization and new models of economic development where knowledge is the main asset required educational systems to modify themselves.

The development of these necessary skills and competencies is one of the most important aims of education. However, the skills and competencies needed for this new world is different from the ones that were required by the industrial mode of production of the past century. With the DeSeCo (The Definition and Selection of Competencies)

* Paper presented at The 6th biennial meeting of the EARLI Special Interest Group 16.

** Corresponding author: Fahretdin Hasan ADAGİDELİ, Istanbul University, Faculty of Hasan Ali Yücel Education, Müşküle Sokak No:1 Vefa/İstanbul, Phone: +90 532 697 3113,
E-Mail: fahretdin.adagideli@istanbul.edu.tr

ISSN:1307-9298

www.iejee.com

project, which was carried out in collaboration with a wide range of scholars, experts and institutions, OECD developed a framework of necessary key competencies (Rychen & Salganik, 2003). Reflectiveness is the underlying concept in this framework. Being reflective requires individuals to reach a level of social maturity that allows them to distance themselves from social pressures, take different perspectives, make independent judgments and take responsibility for their actions, that is, to use metacognitive skills (thinking about thinking), creative and critical abilities (Ananiadou & Claro, 2009).

In another study carried out in the context of the OECD/CERI project on New Millennium Learners (NML), OECD aimed at developing a framework for century competencies for the new generation of learners in the light of the requirements of the 21st century (Ananiadou & Claro, 2009). According to Wolters (2010) core competencies in the 21st century framework appear nearly synonymous with the dimensions of self-regulated learning.

Self-Regulated Learning

The term self-regulation is used to depict individuals' deliberate and effective use of metacognition, motivation, and strategic action in order to attain goals (Butler & Winne, 1995; Perry & Winne, 2006; Schunk & Zimmerman, 2007). Self-regulated individuals exercise metacognition by engaging in and monitoring reflective, analytical forms of thinking. Motivation involves goal setting, attributions, and self-efficacy that effect individuals' commitment to and pursuit and attainment of goals. Strategic action is the external manifestation of individual's metacognition and motivation (Perry & VandeKamp, 2000).

Every child is born with the capacity to self-regulate and this capacity for self-regulation develops with age. Although biological factors like temperament and predisposed reactivity underpin the development of self-regulation in children (Bodrova & Leong, 2007; Berk, Mann, & Ogan, 2006), early experiences play an important role on this development (Boekaerts, 1997).

Recent investigations demonstrate that development of effective self-regulation during preschool years is a prerequisite for school readiness and success (e.g. Denham, Warren-Khot, Bassett, Wyatt, & Perna, 2012; McClelland, Acock, & Morrison, 2006). In fact, self-regulation predicts children's success in school more powerfully than IQ tests or math and reading skills upon school entry (Blair & Razza, 2007; Diamond, Barnett, Thomas, & Munro, 2007).

Self-regulated learning is a special type of self-regulation pertaining to learning that takes place in school or classroom contexts. According to Zimmerman (1998) self-regulated learning is the self-directive process through which learners transform their mental abilities into academic skills. Self-regulated learning process involves academically effective forms of learning involving metacognition, intrinsic motivation, and strategic action (Zimmerman, 1989, 1990, 2002; Winne & Perry, 2000).

Research studies on self-regulated learning emerged in the 1980s, gained prominence in the 1990s and has been growing since then (Dinsmore, Alexander, & Loughlin, 2008). According to Whitebread et al. (2009), self-regulated learning has three main components; metacognitive knowledge (MK), metacognitive regulation (MR); and emotional and motivational regulation (EMR).

Metacognitive knowledge refers to one's knowledge about cognition related to person, tasks and strategies. Metacognitive regulation refers to some procedural verbalization and behaviours including planning, monitoring, control and evaluation that enable to perform activities in a more structured way. Emotional and motivational regulation refers to monitoring and controlling of motivational and emotional experiences about activities being carried out by children. Table 1 shows components and subcomponents of the model along with the descriptions.

Self-Regulated Learning of Preschool Children

Research on self-regulated learning emerged more than two decades ago to answer the question of how students become masters of their own learning processes (Zimmerman, 2008). Unfortunately, due to the long-held view that children under the age of 10 have difficulty in coordinating the cognitive and metacognitive processes required to complete complex, multifaceted tasks (Winne, 1997; Zimmerman, 1990) and very young children are not capable of self-regulated learning in any formal way (Zimmerman, 1989, 1990), most research on self-regulated learning has involved learners in upper-elementary grades through college (Perry, Phillips, & Dowler, 2004).

However, over the last decade, various indications have been found for suggesting traces of self-regulated learning earlier than expected. According to Whitebread, Bingham, Grau, Pino Pasternak and Sangster (2007), studies in laboratory settings and studies based on children's self-report data have been underestimating young children's abilities. Studies in which children have been observed in their natural settings and/or while performing familiar tasks showed that young children can and do engage in self-regulated learning (e.g; Annevirta & Vauras, 2006; Istomina, 1975; Perry, 1998; Perry et al., 2004; Robson, 2010; Sperling, Walls, & Hill, 2000; Whitebread & Coltman, 2010; Whitebread et al., 2007).

Table 1. *Description of components and subcomponents of self-regulated learning (adapted from Whitebread et al. (2009))*

Components	***Subcomponents***	***Descriptions***
Metacognitive Knowledge	Knowledge of Persons	Knowledge about cognition in relation to; Self: Refers to own capabilities, strengths, weaknesses, academic/task preferences, comparative judgements about own abilities Others: Refers to others' processes of thinking, Universals: Refers to universals of people's cognition
	Knowledge of Strategies	Refers to own knowledge in relation to strategies used or performing a cognitive task, where a strategy is a cognitive or behavioural activity that is employed so as to enhance performance or achieve a goal.
	Knowledge of Tasks	Refers to own long term memory knowledge in relation to elements of the task
Metacognitive Regulation	Planning	Refers to the selection of procedures necessary for performing the task, individually or with others
	Monitoring	Refers to the on-going on-task assessment of the quality of task performance (of self or others) and the degree to which performance is progressing towards a desired goal
	Control	Refers to a change in the way a task had been conducted (by self or others), as a result of cognitive monitoring
	Evaluation	Refers to reviewing task performance and evaluating the quality of performance (by self or others).
Motivational-Emotional Regulation	Monitoring	Refers to the assessment of current emotional and motivational experiences regarding the task
	Control	Refers to the regulation of one's emotional and motivational experiences while on task.

Preschool Teachers' Practices Supportive of Self-Regulated Learning

How teachers' practices affect students' self-regulated learning have been researched on various educational levels.

For example, at the elementary level, Hammann, Berthelot, Saia and Crowley (2000) investigated how often teachers coach their students' learning and the relation of this coaching to students' strategic learning. The researchers videotaped 11 teachers during daily classroom instructions on 3 occasions. Then, the students responded to a questionnaire assessing use of learning strategies. The results showed that only in 9% of the videotaped segments, the teachers coached their students' learning (e.g. describing cognitive processes, suggesting strategy use, etc.). The mostly recommended strategies by the teachers were; using learning aids, engaging in metacognitive activity and using elaboration strategies for remembering. Results also indicated that students' strategic learning is significantly related to teachers' coaching of learning.

At the secondary level, Ader (2013) developed a framework for teachers' promotion of students' self-regulated learning. In this ethnographic study with three secondary school mathematics teachers, the researcher focused on the metacognitive component of self-regulated learning. Data were collected via observations of the classrooms, audio recording of various lessons and interviews with the teachers. Also students' work and the materials used by the teachers were collected. The researcher showed that there are differences in the teachers' emphasis on metacognition throughout the stages of the lessons and the activities they used, and during their interactions with the students of different achievement levels and progress with the activities. During the introduction and early stages of the lessons, the students were urged to reflect on their initial work and their knowledge regarding the mathematical concepts involved. Other times, due to the teachers' adoption of a didactic approach to teaching, a lack of emphasis on metacognition was evident.

When it comes to earlier levels of education, due to the findings from studies indicating that children show signs of self-regulated learning earlier than previously thought, researchers have been motivated to study the features of the preschool teaching and learning contexts that are conducive to promoting self-regulated learning of young children in preschool years.

In Stipek, Feiler, Daniels and Milburn (1995) study, children in child-centered preschools and kindergartens were compared to children in didactic, highly academic programs. A total number of 227 children, including children from poor, minority and middle SES families participated. The results showed that children in child-centered classrooms were more willing to cooperate with their classmates and were able to choose from different activities and materials that are interesting and meaningful. On the other hand, the children in teacher-centered classrooms were observed to be more dependent learners, seek for more adult support and be more worried about school.

Perry and Vandekamp (2000), in their observational study in five classrooms (kindergarten to 3rd grade), identified features of classroom environments that promote self-regulated approaches to reading and writing in young children. They found that nonthreatening evaluation practices, involvement in complex reading and writing activities, the provision of autonomy related to what students read and write, and the ability to modify learning tasks to control challenge are all contextual features that improve self-regulated learning in these classrooms.

Whitebread and colleagues investigated the extent to which different learning contexts (e.g., working individually, in a small group, with an adult) appear to afford differential opportunities for children to experience and practice their metacognitive skills. The results of this observational study showed that pair work and small group work along with challenging tasks and teachers' warm approach have been found to be among the practices most supportive of self-regulated learning in preschool settings (Whitebread et al., 2007; Whitebread & Coltman, 2010).

Despite this growing interest on the features of teaching and learning contexts, due to the time-consuming nature of observational studies, it's difficult for researchers to carry out a large-scale study to investigate how much teachers promote self-regulated learning in their classroom. A workable instrument is a need. The only workable instrument for carrying out a large study was developed by Lombaerts, Engels and Athanasou (2007), which was developed for primary education context only. Thus, the aim of this study is to develop a self-report instrument to assess preschool teachers' practices promoting self-regulated learning in their classrooms.

Method

Participants

Participants were 169 preschool teachers in Istanbul. All teachers participated voluntarily in the study. After initial descriptive analysis, 10 teachers were removed from the original sample as these subjects were outliers for normal distribution on several items. For further analysis were carried out with 159 teachers. The majority of the participants were female (96.2%) and worked with children (83%) aged from 4 to 6. These results are consistent with the population means according to Ministry of Education statistics (2014). Table 2 shows the main sample characteristics of the final sample.

Table 2. *Sample characteristics: Participants' demographic and professional background (n= 159)*

Characteristic/category	%
Gender	
Male	3.8
Female	96.2
Year of experience	
0-5 years	41.5
6-10 years	27.7
11 years and above	30.8
Class size	
1-10 children	10.7
11-20 children	67.3
21-30 children	22.0
Age of children	
3-4 year-old	17.0
4-5 year-old	41.5
5-6 year-old	41.5
Types of school	
Public	67.3
Private	32.7

Scale development

For the scale development, Whitebread et al. (2009) model of self-regulated learning for young learners was adopted. As previously mentioned, according to this model, self-regulated learning has three main components: metacognitive knowledge, metacognitive regulation, and emotional-motivational regulation. Under each component, there are also subcomponents.

The metacognitive component has three subcomponents, namely, knowledge of person (KoP), knowledge of task (KoT) and knowledge of strategy (KoS). Total number of 17 items (KoP= 7 items; KoT= 4 items; KoS= 6 items) was formulated in order to assess to what extent preschool teachers provide opportunities for children to be aware of their own and their peers' cognition as well as of their knowledge about task and strategies.

For the metacognitive regulation (MR) component, a total number of 24 items was formulated under four subcomponents, namely: planning (7 items), monitoring (4 items), control (6 items) and evaluation (7 items) in order to assess to what extent preschool teachers provide opportunities for children, while working on tasks, to plan, monitor, control, and evaluate their cognitive processes while working on tasks.

9 items related to the emotional-motivational regulation (EMR) component were formalized under two subcomponents, namely, monitoring of emotions-motivation (5 items) and control of emotions-motivation (4 items) in order to assess to what extent preschool teachers provide opportunities for children to monitor and control their emotional and motivational states.

Total number of items for three components was 50. The numbers of items mainly reflect the proportionality in the number of subcomponents within each component of self-regulated learning. These items were structured as statements, to which the teachers could respond on a Likert-scale ranging from 0 = "never" to 4 = "always".

Testing and refining

50 statements for three components were emailed to four researchers from U.K, Canada, Belgium, and Turkey who are experts both in self-regulated learning and preschool education. The experts rated each statement on four dimensions; whether it was clear; whether it was supportive of self-regulated learning; whether it was suitable for preschool context and whether it was reflective of its given self-regulated learning component. The expert opinions were collected to ensure the face validity of the scale.

In the light of feedback from the experts, 20 statements were removed from the original pool and some statements were reformulated. The latest version of the scale consisted of 30 statements (MK= 10, MR= 13, EMR= 7). Although one of the experts was Turkish who was knowledgeable in Turkish preschool context and curriculum and since the scale's cultural appropriateness was an important concern, to further ensuring the scale's appropriateness for Turkish preschool education context, five preschool teachers examined the statements in terms of clarity and suitability for Turkish context. These teachers rated all the items as suitable for Turkish context. However, following the teachers' suggestions, some terms were changed (e.g. using the "activity" rather than using "task" in the items).

Subsequently, a scale with 30 statements was formulated as a four point Likert-scale, with 0='never', 1='sometimes', 2='often', and 3='always' as possible responses. Metacognitive Knowledge, Metacognitive Regulation, and Emotional and Motivational Regulation comprise 10, 13 and 7 items respectively. Numbers of items for each subcomponent were shown in Table 3. Since knowledge of person subcomponent of MK has various dimensions (metacognitive knowledge of oneself and others) it has more items in this subcomponent in comparison with the other subcomponents.

Table 3. *Numbers of items for each subcomponent*

Components/Subcomponents	# of items
Metacognitive Knowledge	
Person	6
Task	2
Strategy	2
Metacognitive Regulation	
Planning	3
Monitoring	3
Control	3
Evaluation	4
Emotional and Motivational Regulation	
Monitoring	4
Control	3

Results

This section involves the report of empirical instrument testing at item and scale level. First, for ensuring the construct validity of the scale, the underlying factor structure of the scale was examined. Internal consistency of the subscales and correlations between them were also examined.

Exploratory Factor Analysis

To investigate the possible underlying factor structure of 30 items, Exploratory Factor Analysis (EFA) was used. Before running EFA, data was tested for the assumptions of EFA statistics.

According to the assumptions of EFA, the determinant of the correlation matrix indicating singularity in the data should be bigger than .00001 and Kaiser–Meyer–Olkin (KMO) measure should be bigger than .80 to assure adequacy of sample size. Moreover, Barlett's test of sphericity should be significant which indicates that correlation matrix is not an identity matrix.

Although the data satisfied the assumptions of Kaiser–Meyer– Olkin test (KMO= .879) and Barlett's test of sphericity (χ^2=1472.344, p<.001), one of the items, i.e. item 27, did not meet the requirement of normal distribution and the determinant of the correlation matrix was too small. Therefore, item 27 was removed. 10 participants were also removed because their responses were outliers for normal distribution on several items. In order to reach a determinant value of required magnitude, correlation matrix was examined. 8 items were removed (item 4, 5, 6, 11,16,17,23, 28) according to correlation matrix results since their correlation with other items was not sufficient. Therefore, the determinant of the correlation matrix was increased to a new value of 5,519E-005 (> .00001) and a normal distribution was ensured. Thus, EFA was carried out with 159 participants and 21 items.

Principal Axis Factoring method of factor and Promax with Kaiser Normalization method of rotation was used and factors were rotated by Promax with Kaiser Normalization. The results of factor analysis suggested that there were five factors underlying structural framework of the T-SRL. The eigenvalues were 7.8, 1.8, 1.3, 1.2 and 1.1 respectively. The three-factor model accounted for 51.6% of the common variance. The items with high loadings on the first factor reflected emotional and motivational aspects; the second factor reflected metacognitive regulation during task (planning, monitoring and control); while items loading high on the third factor were representing the metacognitive knowledge of task and strategy. The fourth factor represented the metacognitive regulation after task (evaluation) while the last factor's items were loaded by the metacognitive knowledge of person. Corresponding item loadings within the three factor model are presented in Table 4 (See Appendix A for the English version; Appendix B for the Turkish version of the instrument).

Table 4. *Results of the Principal Axis Factoring factor analysis (numbers in the parenthesis correspond to item numbers of the 21-item scale)*

	Factor				
	I	**II**	**III**	**IV**	**V**
Item 26 (#19)	.913				
Item 30 (#21)	.661				
Item 25 (#18)	.660				
Item 29 (#20)	.631				
Item 24 (#17)	.624				
Item 14 (#10)		.729			
Item 13 (#9)		.707			
Item 19 (#13)		.646			
Item 18 (#12)		.524			
Item 12 (#8)		.503			
Item 15 (#11)		.410			
Item 9 (#6)			.881		
Item 8 (#5)			.602		
Item 7 (#4)			.507		
Item 10 (#7)			.492		
Item 20 (#14)				.845	
Item 21 (#15)				.635	
Item 22 (#16)				.482	
Item 2 (#2)					.725
Item 1 (#1)					.615
Item 3 (#3)					.359

The first factor which was labelled "T-SRL emotional and motivational regulation" (EMR; 5 items) determines to what degree teachers allow children to monitor and control their emotion and motivation in classroom context. The second factor was labelled "T-SRL metacognitive regulation during task" (MRdT; 6 items) and determines to what extent teachers provide opportunities to children to plan, monitor and control their tasks while they are involved in tasks. The third factor, labelled "T-SRL metacognitive knowledge of task and strategy" (MKTS; 4 items) concerns teachers' efforts to make children aware of characteristics of several tasks and strategies. The fourth factor, labelled "SRL metacognitive regulation after task" (MRaT; 3 items), aims to determine whether teachers create a classroom context where children evaluate their tasks. The fifth factor labelled "T-SRL metacognitive knowledge of person" (MKP; 3 items) assess to what extend teachers provide opportunities to children to be aware of their own cognition. Cronbach's alpha for the total scale with 21 items was 0.91. The subscales also had good internal consistency scores separately: .842 for the emotional and motivational regulation; .807 for the metacognitive regulation during task; .787 for the metacognitive knowledge of task; .753 for the metacognitive regulation after task; .718 for the metacognitive knowledge of person.

Besides, item-to-subscale correlations ranged from 0.67 to 0.86 over five subscales. Due to acceptable internal consistency scores for the scale and all subscales (a > 0.70), items of the T-SRL emotional and motivational regulation, T-SRL metacognitive regulation during task, T-SRL metacognitive knowledge of task and strategy, T-SRL metacognitive regulation after task and T- metacognitive knowledge of person scale can be considered as a scale, with scores ranging from a minimum of 0 to a maximum of 84. Pearson correlations between subscales ranged from 0.37 to 0.61 (p<.001) and can be considered as important in practice (see Table 5).

In order to examine whether there is a significant difference between scores of teachers who scored at top 27% and bottom 27% on scale, t-test was used. This analysis was accepted as a way of ensuring validity of the scales in the literature (Karakelle & Saraç, 2007)

Table 5. *Correlations between the subscales of the T-SRL practice scale*

	EMR	**MRdT**	**MKTS**	**MRaT**	**MKP**
EMR	1	.580**	.479**	.549**	.523**
MRdT			.610**	.483**	.534**
MKTS				.425**	.535**
MRaT					.371**
MKP					1

**. Correlation is significant at the 0.01 level (2-tailed).

and results showed that there is a significant difference between scores of top 27% and bottom 27% teachers on the scale. This result provides evidence for the validity of the scale.

The scores obtained by the top and bottom 27% of teachers according to their scores from the scale was examined on the subscales to provide evidence for consistency between scale and subscales. This analysis was accepted as a way of ensuring validity of the scales in the literature (Moore & Foy; 1997). The findings verify that each subscale discriminate between those who score high and low on the scale (p<.001; see Table 6). That is an indication that there is a consistency between scale and each subscale and it is evidence of validity of T-SRL.

In order to examine the item-total correlation and the discrimination of items, Pearson correlation analysis and t-test was used. These analysis were accepted as a way of ensuring reliability of the scales in the literature (Onat & Otrar, 2010). Results showed that each item in the scale had positive statistically significant relation with the total score (p<.001). Moreover, there are significant differences between teachers who got highest scores (top 27%) and those who got lowest scores (bottom 27%) for each item (p<.001). These findings assured that all items belonged to the structure of the scale and each item has discrimination power (See Appendix C).

Table 6. *Discrimination analysis of the subscales among the top and bottom scorers from the total scale*

	t	*df*	*p*
EMR	-15.549	84	.000
MRdT	-13.716	84	.000
MKTS	-13.474	84	.000
MRaT	-11.329	84	.000
MKP	-11.504	84	.000

Conclusion

Results of the present study showed that T-SRL is a reliable and a valid instrument to assess preschool teachers' classroom practices promoting self-regulated learning of their children at the age of 3-6. In the present study, a relatively small yet diverse group of preschool teachers participated voluntarily. Therefore, further research with larger groups is needed.

Moreover, this study was conducted in the Turkish context. Cross-cultural studies in which the T-SRL will be administered would show the usability of the instrument in different cultures. Besides, these studies would reveal comparative results showing how practices of teachers diverse across different culture.

Whitebread et al. (2009) suggested three main components describing self-regulatory abilities of young children: Metacognitive knowledge, metacognitive regulation and emotional-motivational regulation. While metacognitive knowledge has 3 subcomponents as knowledge of person, strategy and task. Furthermore knowledge of person is divided into 3 subcomponents; knowledge of self, other and universals. Metacognitive regulation consists of 4 subcomponents; planning, monitoring, control and evaluation. Lastly, monitoring and control of emotions and motivations formalized as subcomponents of emotional-motivational regulation. Preliminary results of validity and reliability analysis of T-SRL showed that the factor structure of the instrument was different from the structure presumed by Whitebread et al. (2009). However, structure of T-SRL made sense considering the distribution of factors. Considering the similarities between the initial theoretical framework and what was found as a result of the analysis conducted, emotional-motivational regulation and metacognitive knowledge of person are the common factors.

The major difference found between framework of Whitebread et al. (2009) and the factor structure found in this study, appeared in the metacognitive regulation component. While this component comprises 4 subcomponents in framework of Whitebread et al., the results of this study suggested a two-phase factor structure, i.e. metacognitive regulation during and after tasks. Planning, monitoring and control, which could be considered as metacognitive regulation activities while working on a task, formed the *metacognitive regulation during task* subscale of T-SRL. Evaluation, which could be considered as regulatory activities after task performance appeared as *metacognitive regulation after task* in the present instrument. This might be resulting from teachers' focus on the sequential progress of students' activities in the classroom, rather than emphasising the orchestration of multiple subcomponents within metacognitive regulation. This difference between how researchers have in mind and how teachers interpret may be due to the level of understanding on how children self-regulate their learning. Since the researchers focus more on self-regulatory activities of children, they have a more detailed conceptualisation. Preschool teachers that took part in this study did not have a specific training about self-regulation and metacognition. Hence, manifestations of their conceptualisation of metacognitive regulation can be less sophisticated in its dimensionality.

Items presumed as metacognitive knowledge of others were eliminated according to factor analysis. This could once again be resulting from preschool teachers not having awareness regarding the promotion of metacognitive knowledge of other persons. Alternatively, there can be a problem with the wording of these items (item 4, 5, 6). Metacognitive knowledge of task and strategy are also separate factors of the aforementioned framework. However, in the present factor distribution, these two factors aggregated in the same factor.

As suggested in the literature, the scale with items left should be further analysed with confirmatory factor analysis to assure factor structure of the scale. However, there is another alternative for further improving the scale. The 30 item-scale can be administered to teachers again after editing the removed items' wording. The advantage of this latter approach would be to acquire the same factor structure presumed in Whitebread et al. (2009).

There is a need for instruments to assess classroom practices of preschool teachers for promoting self-regulated learning. Although there are instruments appropriate for primary classrooms, there is a lack of such an instrument at the preschool level. Although there are concerns regarding the use of self-report measures, a self-report instrument is a practical measurement tool for teachers to evaluate their classroom practices, thus allowing researchers to conduct large-scale studies. Therefore, T-SRL presented in this study would be the first step to fill the gap in research efforts towards developing such a measurement instrument. Yet metacognitive and self-regulatory researchers highlight the importance of checking construct validity of such self-report instruments since participants could reflect intentionally or unintentionally a distorted reflection of their actions in their responses to self-report instruments (e.g. Veenman, 2005). Checking the consistency of data from teachers' self-reports and data from experts' observations of teachers' practices would provide further evidence for validity of the instrument.

Implications

The scale developed in the present study, would be a useful instrument not only for researchers in self-regulation and preschool education but also for practitioners in preschools. As mentioned earlier in this paper, there is a lack of instruments to assess practices of preschool teachers to promote self-regulation although there are studies and instruments assessing primary education teachers' practices (Lombaerts et al., 2007; Perry & VandeKamp, 2000). Moreover, the scale would help teachers to develop understanding and awareness of self-regulated learning, therefore, to learn how to create classroom context enriching self-regulated learning and to acknowledge the levels of their children's self-regulation abilities. It would also be a worthwhile effort to see whether changes occur in teachers' reports of their teaching practices and the factor structures of their responses with differential levels of training given to teachers about self-regulation and practices to promote students' self-regulated learning.

• • •

References

Ader, E. (2013). A framework for understanding teachers' promotion of students' metacognition. International Journal for Mathematics Teaching & Learning. Retrieved June 10, 2014 from http://www.cimt.plymouth.ac.uk/journal/ader.pdf

Ananiadou, K. and Claro, M. (2009). 21st century skills and competences for new millennium learners in OECD countries. Retrieved from Paper Prepared for Organization for Economic Cooperation and Development: http://www.oecd-ilibrary.org/education/21st-century-skills-and-competences-for-new-millennium-learners-in-oecd-countries_218525261154.

Annevirta, T., & Vauras, M. (2006). Developmental changes of metacognitive skill in elementary school children. Journal of Experimental Education, 74, 197–225.

Berk, L.E., Mann, T.D., & Ogan, A.T. (2006). Make-believe play: Wellspring for the development of self-regulation. In D.G. Singer, R. Golinkoff, & K. Hirsh-Pasek (Eds.), Play = learning: How play motivates and enhances children's cognitive and social-emotional growth (pp. 74 – 100). New York: Oxford University Press.

Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy abilities in kindergarten. Child Development, 78, 647–663.

Bodrova, E. & Leong, D. J. (2007). Tools of the mind: the Vygotskian approach to early childhood education (2nd ed.). Columbus, OH: Merrill/Prentice Hall.

Boekaerts, M. (1997). Self-regulated learning: A new concept embraced by researchers, policy makers, educators, teachers, and students. Learning and Instruction, 7(2), 151–86.

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. Review of educational research, 65(3), 245-281.

Denham, S. A., Warren-Khot, H. K., Bassett, H. H., Wyatt, T., & Perna, A. (2012). Factor structure of self-regulation in preschoolers: Testing models of a field-based assessment for predicting early school readiness. Journal of Experimental Child Psychology, 111, 386-404.

Diamond, A., Barnett, W.S., Thomas, J., & Munro. S. (2007). Preschool program improves cognitive control. Science, 318, 1387-1388.

Dinsmore, D. L., Alexander, P. A., & Loughlin, S. M. (2008). Focusing the conceptual lens on metacognition, self-regulation, and self-regulated learning. Educational Psychology Review, 20(4), 391-409.

Hamman, D., Berthelot, J., Saia, J., & Crowley, E. (2000). Teachers' coaching of learning and its relation to students' strategic learning. Journal of Educational psychology, 92(2), 342.

Istomina, Z. M. (1975). The development of voluntary memory in preschool age children. Social Psychology,13, 5–64.

Karakelle, S., & Saraç, S.(2007). Çocuklar için üst bilişsel farkındalık ölçeği (ÜBFÖ-Ç) A ve B formlari: Geçerlik ve güvenirlik çalışması.Türk Psikoloji Yazilari, 10(20), 85-103.

Lombaerts, K., Engels, N., & Athanasou, J. (2007). Development and validation of the self-regulated learning inventory for teachers. Perspectives in Education, 25(4), 29-47.

McClelland, M. M., Acock, A. C., & Morrison, F. J. (2006). The impact of kindergarten learning-related skills on academic trajectories at the end of elementary school. Early Childhood Research Quarterly, 21(4), 471 – 490.

Ministry of Education (2014). National education statistics 2013-2014. Ankara: Milli Eğitim Bakanlığı.

Moore, R. W., & Foy, R. L. H. (1997). The scientific attitude inventory: A revision (SAI II). Journal of Research in Science Teaching, 34(4), 327-336.

Onat, O., & Otrar M. (2010). Bilişsel duygu düzenleme ölçeğinin Türkçeye uyarlanması: Geçerlik ve güvenirlik çalışmaları [Adaptation of cognitive emotion regulation questionnaire to Turkish: Validity and reliability studies], Marmara Üniversitesi Atatürk Eğitim Fakültesi Eğitim Bilimleri Dergisi, 31, 123-143.

Paris, S. G., & Paris, A. H. (2001). Classroom applications of research on self-regulated learning. Educational psychologist, 36(2), 89-101.

Perry, N. E. (1998). Young children's self-regulated learning and contexts that support it. Journal of Educational Psychology, 90, 715–729.

Perry, N., Phillips, L., & Dowler, J. (2004). Examining features of tasks and their potential to promote self-regulated learning. The Teachers College Record,106(9), 1854-1878.

Perry, N. E., & VandeKamp, K. O. (2000). Creating classroom contexts that support young children's development of self-regulated learning. International Journal of Educational Research, 33, 821–843.

Perry, N. E., & Winne, P. H. (2006). Learning from learning kits: gStudy traces of students' self-regulated engagements with computerized content. Educational Psychology Review, 18(3), 211-228.

Robson, S. (2010). Self-regulation and metacognition in young children's selfinitiated play and Reflective Dialogue. International Journal of Early Years Education, 18(3), 227-241.

Rychen, D. S. & Salaganik, L. H. (2003). Introduction. In D. S. Rychen, & L. H. Salaganik (Eds.), Key competencies for a successful life and a well-functioning society (pp. 1-12). Göttingen: Hogrefe & Huber.

Schunk, D. H., & Zimmerman, B. J. (2007). Influencing children's self-efficacy and self-regulation of reading and writing through modeling. Reading & Writing Quarterly, 23(1), 7-25.

Sperling, R.A., R.T. Walls, and Hill L. A. (2000). Early relationships among self-regulatory constructs: Theory of mind and pre-school children's problem solving. Child Study Journal 30(4), 233-252.

Veenman, M. V. J. (2005). The assessment of metacognitive skills: What can be learned from multi-method designs. In C. Artelt, & B. Moschner (Eds.), Lernstrategien und metakognition: Implikationen für forschung und praxis, (pp. 1-30). Berlin: Waxmann.

Whitebread, D., Bingham, S., Grau, V., Pino Pasternak, D., & Sangster, C. (2007). Development of metacognition and self-regulated learning in young children: The role of collaborative and peer-assisted learning. Journal of Cognitive Education and Psychology, 3, 433–455.

Whitebread, D., & Coltman, P. (2010) Aspects of pedagogy supporting metacognition and mathematical learning in young children; evidence from an observational study. ZDM The International Journal on Mathematics Education, 42 (2), 163-178.

Whitebread, D., Coltman, P., Pino Pasternak, D., Sangster, C., Grau, V., Bingham, S., et al. (2009). The development of two observational tools for assessing metacognition and self-regulated learning in young children. Metacognition and Learning, 4(1), 63–85.

Winne, P. H. (1997). Experimenting to bootstrap self-regulated learning. Journal of Educational Psychology, 89, 397-410.

Winne, P. H., & Perry, N. E. (2000). Measuring self-regulated learning. In P. Pintrich, M. Boekaerts, & M. Zeidner (Eds.), Handbook of self-regulation, (pp. 531-566). Orlando, FL: Academic Press.

Wolters, C. A. (2010). Self-regulated learning and the 21st century competencies. Retrieved from Paper Prepared for the NRC Planning Meeting on 21st Century Competencies: http://www.hewlett.org/uploads/Self_Regulated_Learning__21st_Century_Competencies.pdf

Zimmerman BJ (1989). A social cognitive view of self-regulated academic learning. Journal of Educational Psychology, 81(3), 329-339.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. Educational Psychologist, 25(1), 3-17.

Zimmerman BJ 1998. Developing self-fulfilling cycles of academic regulation: An analysis of exemplary instructional models. In D. H. Schunk, & B. J. Zimmerman, (eds). Self-regulated learning. From teaching to self-reflective practice (pp.1–10). New York: Guilford Press.

Zimmerman BJ (2002). Becoming a self-regulated learner: An overview. Theory into Practice, 41(2), 64-70.

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. American Educational Research Journal, 45(1), 166-183.

APPENDIX A

Dear teachers,
We are conducting a research study on early year teachers' classroom practices. Please read the following statements and indicate how frequently these teaching activities occur in your classroom regarding the 2013-2014 academic year. Thank you.

Classroom practices **0= Never** **1=Rarely** **2=Usually** **3=Always**				
1. I provide opportunities for my children to be aware of how they learn.	0	1	2	3
2. I provide opportunities for my children to be aware of their task preferences.	0	1	2	3
3. I provide opportunities for my children to develop awareness about their strengths and weaknesses in learning.	0	1	2	3
4. I draw my children's attention to various strategies they can use for classroom tasks.	0	1	2	3
5. When I talk about strategies, I draw attention to similarities and differences among various strategies.	0	1	2	3
6. I provide opportunities for my children to develop their awareness that there are various types of tasks	0	1	2	3
7. I provide opportunities for my children to detect similarities and differences across tasks.	0	1	2	3
8. I encourage my children to identify what resources they will need to complete a task before they begin working.	0	1	2	3
9. I let my children make decisions about how to work.	0	1	2	3
10. While working on tasks, I encourage my children to stop and look back on what they did.	0	1	2	3
11. I teach my children how to check their progress.	0	1	2	3
12. I teach my children how to seek help appropriately.	0	1	2	3
13. I provide opportunities for my children to apply a previously learned strategy.	0	1	2	3
14. I want my children to evaluate the quality of their work.	0	1	2	3
15. I teach my children how to evaluate their learning.	0	1	2	3
16. I provide opportunities for my children to evaluate the quality of their peers' performances.	0	1	2	3
17. I help my children to develop awareness about their emotional reactions while working on tasks.	0	1	2	3
18. I teach my children to monitor their friends' emotional reactions while working on tasks.	0	1	2	3
19. I help my children to develop awareness about their motivational level regarding the task.	0	1	2	3
20. I teach my children various attention focusing strategies.	0	1	2	3
21. I teach my children how to resist distraction.	0	1	2	3

APPENDIX B

Değerli Öğretmenim,
Okulöncesi öğretmenlerinin öğrencilerine sağlayabildikleri öğrenme-öğretme ortamlarının niteliğini belirlemek amacıyla bir çalışma yürütmekteyiz. Bu çalışma kapsamında sizden iki ölçek doldurmanızı rica ediyoruz. Her iki ölçeği de 2013-2014 öğretim yılına ait deneyimlerinizi göz önünde bulundurarak cevaplayınız. Katkınız için teşekkür ederiz.

SINIF İÇİ ETKİNLİKLER 0= Hiçbir zaman 1=Nadiren 2=Sık sık 3=Her zaman				
1. Öğrencilerime, nasıl öğrendiklerini fark etmeleri için fırsatlar sunarım.	0	1	2	3
2. Öğrencilerime, ne tür etkinlikleri tercih ettiklerini anlamaları için fırsatlar sunarım.	0	1	2	3
3. Öğrencilerime, öğrenmedeki güçlü ve zayıf yönlerinin farkında olmaları için fırsatlar sunarım.	0	1	2	3
4. Öğrencilerime, etkinliklerde kullanabilecekleri farklı farklı yöntemlerin olduğuna dikkat çekerim.	0	1	2	3
5. Bir etkinlik için kullanılabilecek çeşitli yöntemler arasındaki farklılık ve benzerliklere dikkat çekerim.	0	1	2	3
6. Öğrencilerime, farklı etkinlik türleri olduğunun farkına varabilmeleri için fırsatlar sunarım.	0	1	2	3
7. Öğrencilerime etkinlik türleri arasındaki farklılık ve benzerlikleri görmeleri için fırsatlar sunarım.	0	1	2	3
8. Öğrencilerimi, bir etkinliğe başlamadan önce etkinlikte ihtiyaç duyacakları materyalleri belirlemeye teşvik ederim.	0	1	2	3
9. Öğrencilerimin, nasıl çalışacaklarına kendilerinin karar vermelerine izin veririm.	0	1	2	3
10. Öğrencilerimi, bir etkinlik üzerinde çalışırken geriye dönüp yaptıklarına bakmaya teşvik ederim.	0	1	2	3
11. Öğrencilerime, bir etkinlik üzerinde çalışırken kendi ilerlemelerini nasıl kontrol edeceklerini öğretirim.	0	1	2	3
12. Öğrencilerime, ne zaman ve ne şekilde yardım istemeleri gerektiğini öğretirim.	0	1	2	3
13. Öğrencilerime, önceden öğrendikleri yöntemleri kullanmaları için fırsatlar sunarım.	0	1	2	3
14. Öğrencilerimden, kendi öğrenmelerini değerlendirmelerini isterim.	0	1	2	3
15. Öğrencilerime, öğrenmelerini nasıl değerlendireceklerini öğretirim.	0	1	2	3
16. Öğrencilerime arkadaşlarının performanslarını değerlendirmeleri için fırsatlar sunarım.	0	1	2	3
17. Öğrencilerime, etkinlikler üzerinde çalışırken verdikleri duygusal tepkilerin farkında olmaları için yardımcı olurum.	0	1	2	3
18. Öğrencilerime, arkadaşlarının etkinlikler üzerinde çalışırken verdikleri duygusal tepkilerini izlemeyi öğretirim.	0	1	2	3
19. Öğrencilerime, etkinliğe ilişkin motivasyon düzeylerinin farkında olmaları için yardımcı olurum.	0	1	2	3
20. Öğrencilerime dikkat toplama yöntemlerini öğretirim.	0	1	2	3
21. Öğrencilerime dikkat dağıtıcı şeyler karşısında nasıl direneceklerini öğretirim.	0	1	2	3

Appendix C: The discrimination of items and the item-total correlations

	Item-total correlation			Discrimination of items		
	N	***r***	***p***	***t***	***df***	***p***
Item1	159	.589	.000	-8.305	84	.000
Item2	159	.543	.000	-7.682	84	.000
Item3	159	.597	.000	-8.733	84	.000
Item4	159	.601	.000	-9.796	84	.000
Item5	159	.571	.000	-8.764	84	.000
Item6	159	.593	.000	-8.688	84	.000
Item7	159	.635	.000	-9.991	84	.000
Item8	159	.563	.000	-8.085	84	.000
Item9	159	.544	.000	-5.842	84	.000
Item10	159	.640	.000	-8.751	84	.000
Item11	159	.669	.000	-10.362	84	.000
Item12	159	.554	.000	-8.032	84	.000
Item13	159	.672	.000	-9.890	84	.000
Item14	159	.552	.000	-8.303	84	.000
Item15	159	.670	.000	-10.510	84	.000
Item16	159	.515	.000	-6.598	84	.000
Item17	159	.623	.000	-9.823	84	.000
Item18	159	.557	.000	-7.345	84	.000
Item19	159	.645	.000	-9.771	84	.000
Item20	159	.677	.000	-10.856	84	.000
Item21	159	.757	.000	-13.790	84	.000

www.iejee.com

This page is intentionally left blank

International Electronic Journal of Elementary Education, 2015, 7(3), 441-450.

Impacting Children's Health and Academic Performance through Comprehensive School Physical Activity Programming

Timothy A. BRUSSEAU*
University of Utah, USA

James C. HANNON
University of Utah, USA

Received: 20 December 2014 / Revised: 13 May 2015 / Accepted: 19 May 2015

Abstract

Physical activity is associated with numerous academic and health benefits. Furthermore, schools have been identified as an ideal location to promote physical activity as most youth attend school regularly from ages 5-18. Unfortunately, in an effort to increase academic learning time, schools have been eliminating traditional activity opportunities including physical education and recess. To combat physical inactivity in you, numerous organizations are promoting a Comprehensive School Physical Activity Program to encourage academic achievement and overall health. Comprehensive School Physical Activity Programs include five components and should be centered around 1) quality physical education, 2) physical activity before and after school, 3) physical activity during school (both recess and classroom activity), 4) staff involvement, and 5) family and community engagement.

Keywords: Physical education, recess, youth, CSPAP.

Introduction

Physical activity has been associated with increases in school performance including concentration, memory, and classroom behavior (i.e. Strong et al., 2005). Specifically, elementary school aged girls performed better in math and reading when they had additional physical activity time (Carlson et al., 2008). Furthermore, Sallis and colleagues (1999) have stated that increases in school PA opportunities do not hinder academic performance; in fact they suggest the inverse may be true.

Unfortunately, today's children not accumulating recommended levels of physical activity (i.e. Brusseau, Tudor-Locke, & Kulinna, 2013). Physical inactivity is associated with numerous health risks, including heart disease, cancer, diabetes, hypertension, as well as anxiety and depression (Kohl & Cook, 2013). Lee and colleagues (2012) have

* Timothy A Brusseau, University of Utah, Department of Exercise and Sport Science, 250 S 1850 E Rm 205 Salt Lake City UT 84112 USA. Phone: 1-801-809-4400, mail: Tim.brusseau@utah.edu

ISSN:1307-9298

suggested that the health burden of physical inactivity approaches that of smoking and obesity. The Centers for Disease Control and Prevention (CDC; 2012) has reported that less than half of youth are accumulating the recommended 60 minutes of activity each day. The prevalence of physical inactivity among school aged children has contributed to the substantial rise in overweight and obesity (Tremblay & Willms, 2003). Obesity has increased in the US dramatically over the past ten years with approximately 32% of girls and 37% of boys classified as overweight or obese (Ogden et al., 2006). The obesity epidemic is affecting children of all ages including young children and adolescents and when obesity occurs during adolescents, it tends to persist into adulthood (Deckelbaum & Williams, 2001).

Physical activity (PA) during childhood has shown to be effective in preventing health problems later in life (Strong et al., 2005). PA is associated with strong bones and muscles, decreases in the likelihood of obesity, type 2 diabetes, and heart disease and it promotes positive mental health (USDHHS, 2008). To decrease the risk of overweight and obesity, it is recommended that children engage in moderate to vigorous physical activity (MVPA) for at least 60 minutes each day (USDHHS, 2008) or at least 12,000 steps/day (Colley, Janssen, & Tremblay, 2012). PA peaks at about age 12 (Tudor-Locke et al., 2011) making the elementary school the ideal time to provide PA opportunity and training. Due to the accessibility of children, schools are an ideal setting for promoting PA (CDC, 2011). Most children are in school for 30-35 hours per week. However, the opportunity for children to be physically active during school has decreased due to many factors including an increase in vehicle transportation to school, environmental factors, school policy, and reducing time children spend in physical education (PE) and at recess (NASPE, 2006). The more access children have to physical activity the more active they will be at school (Brusseau & Kulinna, 2015).

Recently, the CDC (2013) and SHAPE America (NASPE, 2008) have suggested that one solution to the lack of childhood physical activity in Comprehensive School Physical Activity Programming (CSPAP). A CSPAP is a multi-component approach by which schools use all available opportunities for students to be physically active, meet the nation recommendation of 60 minutes of PA per day, and develop the knowledge, skills, and confidence to be physically active for a lifetime (CDC, 2013). CSPAP has five components (See Figure 1) including quality physical education, physical activity during the school day (e.g. recess and classroom PA), PA before and after school, staff involvement, and family and community engagement. There are two main goals of CSPAP: (1) to provide a variety of school-based physical activities to enable all students to participate in 60 minutes of moderate-to-vigorous PA each day and (2) to provide coordination among the CSPAP components to maximize understandings, application, and practice of the knowledge and skills learned in physical education so that all student will be fully physically educated and well-equipped for lifetime of PA (CDC, 2013; NASPE, 2008). Below is a detailed description of each component and strategies for implementation.

Quality Physical Education

Physical education is an academic subject that is the foundation for the CSPAP (CDC, 2013). Quality PE should be guided by national PE/PA standards, be student-centered and developmentally appropriate, have a core focus on physical activity and motor skill development, teach management skills and promote self-discipline, include all students, emphasize proper learning over outcome, promote lifetime personal wellness, and teach responsibility and cooperation and promote diversity (Darst, Pangrazi, Brusseau, & Erwin, 2015). The two major outcomes of physical education should be physical activity and health. Furthermore, children should be active at least 50% of class time (CDC, 2013).

Quality physical education provides the necessary skills and may encourage young people to be active adults (Darst et al., 2015).

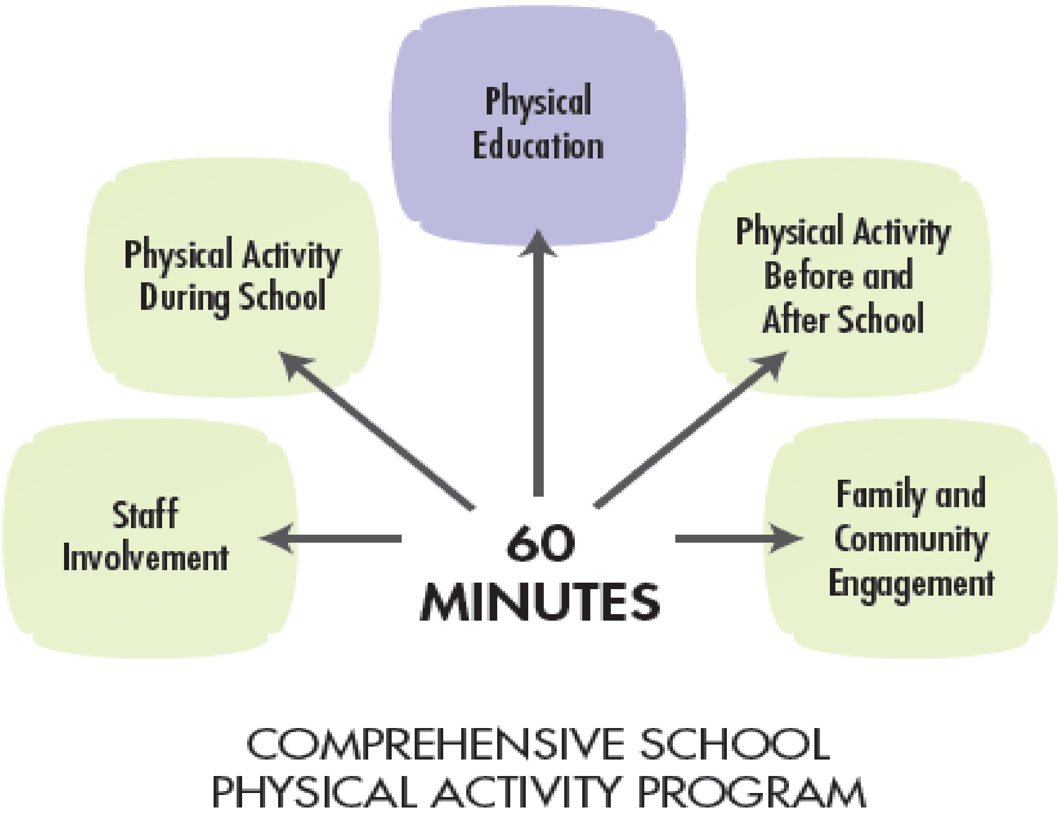


Figure 1. CSPAP (CDC, 2013)

At the elementary school level, all students should be required to take PE and have a minimum of 150 minutes per week. PE classes should be in line with the class sizes of other academic subjects, should be taught by a trained specialist and should have adequate equipment and facilities (CDC, 2013). Quality physical education should also include regular assessment and PA should not be used as punishment. Quality physical education has shown to contribute up to 25% of daily physical activity (Brusseau, Kulinna, Tudor-Locke, & Ferry, 2013) and youth are significantly more active on days that they have physical education class (Brusseau, Kulinna, Tudor-Locke, van der Mars, & Darst, 2011).

Physical Activity Before and After School

Before and after school programs provide opportunities to promote physical activity by providing structured and unstructured physical activity opportunities and teaching youth the skills needed for a lifetime of activity (Trost, Rosenkranz, & Dzewaltowski, 2008). The CDC (2011) and USDHHS (2012) suggest that before/after school programs have the ability to: 1) practice what they have learned in physical education, 2) work toward the nationally recommended 60 minutes of daily physical activity, 3) become more adequately prepared for learning, 4) engage in safe, social, and supervised activities, and 4) identify activities they enjoy and might engage in long term. Numerous scholars have identified the ability of before and after school programming to increase youth physical activity (i.e. Trost et al., 2008) and decrease overweight (Salcedo Aguilar et al., 2010).

The CDC (2013) in their CSPAP recommendations state that “before- and after-school physical activity programs offer students an opportunity to be physically active instead of waiting in a sedentary setting for the school day to begin or end. These programs may include a walking and biking to school program (i.e. walking school bus), clubs and intramural programs (i.e., programs that are developmentally appropriate and give an opportunity for all students to participate), informal free play on school grounds, and integrating physically active homework during out of school hours. Finally, before- and after-school physical activity programs can be coordinated with community-based organizations (e.g., YMCAs, community parks and recreation) and delivered in school settings (CDC, 2013).

Physical Activity during School

In addition to physical education, schools can offer physical activity in a variety of settings during the school day. The main ways students can participate in physical activity during the school day are recess, and physical activity integrated into lessons or classroom activity breaks. These opportunities can be offered to all grade levels. Schools can facilitate increased physical activity during the school day by encouraging students to be active; providing students with space, facilities, equipment and supplies that make participating in activity appealing; and providing organized times and structured physical activities for interested students (CDC, 2013).

Recess. Recess offers an excellent opportunity for children to engage in free play or semi-structured physical activity during the school day, and allows them to apply skills learned in PE. Recess should not, however, replace physical education or be used to meet time requirements set forth in PE policies (CDC, 2013). Recess has seen a reduction by more than 20% of school districts in order to allocate more time for English and Math (Lee, Burgeson, Fulton, & Spain, 2007) and this trend has continued over the past decade. Participation in recess is associated with academic benefits, such as improving attentiveness, concentration, behavior, and time on-task in the classroom (i.e. Pellegrini & Bjorklund, 2010) and also provides a unique contribution to a child’s creative, social, and emotional development (Ramstetter, Murray, & Garner, 2010). Strategies for implementing recess in elementary schools include: providing age-appropriate equipment for students, having adult recess supervisors encourage students to be physically active, and providing semi-structured activity that involves activity stations (e.g., jump rope, four square, hopscotch stations) (CDC, 2013). Simple modifications including semi-structure and equipment has shown to significantly increase youth physical activity at recess (i.e. Larson, Brusseau, Chase, Heinneman, & Hannon, 2014) as has adding playground markings (Esaclante, Garcia-Hermoso, Backx, & Saaverda, 2014).

Physical Activity Integrated into Classroom Lessons. Integrating physical activity within classrooms as part of planned lessons that teach academic subjects through movement can increase students’ overall physical activity and improve time-on-task and attentiveness (Mahar et al., 2006; Donnelly & Lambourne, 2011; Erwin, Beighle Morgan, & Noland, 2011; Goh et al., 2014). Physical activity can be integrated into academic subjects for all grade levels, not just elementary school grades. This type of physical activity helps establish an active school environment, and enhance students’ learning experiences. Examples of evaluated programs or interventions that have shown improvements in students’ physical activity levels include the North Carolina Energizers (www.eatsmartmovemorenc.com/Energizers/Elementary.html) and Take 10! (www.take10.net/). A specific example of a Take 10! lesson might include completing imaginary jump roping while counting using odd numbers on every jump or completing addition or subtraction problems based on the number of jumps a student might complete.

Physical Activity Breaks in the Classroom. Physical activity breaks in the academic classroom allow students to take a mental and physical break from current academic tasks. These breaks can occur at any time during the school day, last from 5–30 minutes, and occur all at one time or several times during the school day. Bershwinger and Brusseau (2013) found that 10 minute activity breaks can lead to an increase of 1000 steps/day. Chaddock, Hillman, Buck, and Cohen (2011) found that even a short break from focused concentration allows the brain to consolidate information for better retention and retrieval of memory.

Studies (CDC, 2010) have found that offering physical activity breaks during standard classroom instruction may have favorable associations with some indicators of cognitive functioning (e.g., attention/concentration); academic behaviors (e.g., classroom conduct); and/or academic achievement (e.g., test scores). Examples of physical activity breaks in the classroom include:

- Stretching or relaxation break.
- Walking around the classroom or hallway.
- Jumping with an invisible jump rope.
- Doing squats, push-up, or sit-ups.
- Passing a ball around the classroom

Staff Involvement

School employees play an integral role in a school's CSPAP (CDC, 2013). School employee wellness programs improve staff health, increase physical activity levels, and are cost effective (Osilla et al., 2012). When school staff commits to good health practices, they are positive role models for students, and may show increased support for student participation in physical activity (Cullen et al., 1999). Support for school employee wellness and leadership training contribute to the overall culture of physical activity at a school. Teachers and other school staff members can integrate physical activity into classroom academic instruction and breaks, and support recess, intramurals, and other physical activity offerings. A simple program to encourage faculty to actively engage in physical activity with their students or in their classrooms is the GIMME5 initiative where many schools will reward teachers for every week they implement five CSPAP components with their students they get entered into a lottery or have access to external rewards like free weekly membership at a local fitness center. Additionally, school employees can be positive role models for students by demonstrating active lifestyle choices in and out of school (CDC, 2013). It is also important to integrate staff wellness activates into a CSPAP program. These might include a staff wellness room, cooking classes, or community opportunities (i.e. gym passes) for faculty and staff.

Family and Community Engagement

Family and community engagement in school-based physical activity programs provides numerous benefits (CDC, 2012). Research shows that youth participation in physical activity is influenced by participation and support of parents and siblings (Lee et al., 2010). When families are active together, they spend additional time together and experience health benefits (Lee et al., 2010). Parents, guardians, or other family members can support a CSPAP by participating in evening or weekend special events, or by serving as physical education or physical activity volunteers. Physical activity homework from the classroom or physical education teacher might require the family to be active as part of the students at home assignments (Williams & Hannon, 2013). An example might include requiring the family to participate in a variety of activities at home and calculate their heart rates during each activity to determine which are light, moderate, or vigorous.

Community involvement allows maximum use of school and community resources and creates a connection between school and community-based physical activity opportunities. Community organizations might provide programs before or after school or establish joint-use or shared-use agreements with schools (CDC, 2013). Community events including walkathons or Zumba decathlons encourage everyone to be active and at the same time raising money for local charities.

The Importance of Coordination of the CSPAP

The CDC (2013) suggests that in order to maximize physical activity opportunities in schools they need to be coordinated, well planned, and thoughtfully executed and evaluated, thus creating a culture of physical activity that is integrated throughout the school environment and reaches beyond the school and into the community. A school that establishes student health as a priority will form a CSPAP team and develop a comprehensive physical activity plan that includes all of the components described in the preceding sections (CDC, 2013). A CSPAP reflects the social, emotional, and cultural needs of students, their families, and the broader community, thereby establishing a strong social and culturally supportive environment for students, families, and communities to engage in physical activity (CDC, 2013).

Strong support from school administration and staff involvement in the CSPAP are important to school program success. The physical educator is ideally positioned to address issues of physical inactivity during the school day, as they understands the school environment, parents, the community, correlates of physical activity, and unique characteristics and needs of the school culture (CDC, 2013). From this perspective, the physical education teacher is ideally situated to lead the development and implementation of the CSPAP, with strong support from other staff, volunteers, and teachers (Castelli & Beighle, 2007). In addition, classroom teachers and school staff play a vital role in promoting the health of their students by integrating physical activity opportunities throughout the school day (Pangrazi, Beighle, & Pangrazi, 2009) and serving as positive role models while supporting student participation in physical activity (NASPE, 2008). When coordinated approaches are implemented they have begun to illustrate positive impacts on children's physical activity (i.e. Burns, Brusseau, & Hannon, 2015; Kulinna, Brusseau, Cothran, & Tudor-Locke, 2012)

The following sections define and describe steps to develop, implement, and evaluate a CSPAP (CDC, 2013).

1. Establish a team or committee and designate a Physical Activity Leader.
2. Conduct an assessment of existing physical activity opportunities.
3. Create a vision statement, goals, and objectives for your CSPAP.
4. Identify the outcomes or specific changes that will be direct results of program implementation.
5. Identify and plan the activities for your CSPAP.
6. Implement your CSPAP.
7. Evaluate your CSPAP.

The CDC (2013) also recommends creative ways to schedule physical activity throughout the school day:

- Adding 5 more minutes to recess time.
- Integrating physical activity into academic lessons at least once per day.
- Adding physical activity clubs during times that students arrive early at school in the mornings, or depart late after school.

- Hosting a morning movement activity for each grade level in the school, prior to the start of the school day.
- Developing intramural sport programs and physical activity clubs.

Conclusion

CSPAP provide a school and community program geared to maximizing physical activity in children. Increases in physical activity are associated with improved academic performance and overall health. With a little planning and commitment from all school personnel, CSPAP has great potential to make improvements at very little cost.

• • •

References

Bershwinger, T, & Brusseau, T. A. (2013). The impact of classroom activity breaks on the school-day physical activity of rural children. International Journal of Exercise Science, 6, 6.

Brusseau, T. A., Kulinna, P. H., (2015). An Examination of Four School Physical Activity Models on Children's Step Counts and MVPA. Research Quarterly for Exercise and Sport, 86 (1), 89-93.

Brusseau, T. A., Kulinna, P. H., Tudor-Locke, C., van der Mars, H., & Darst, P. W. (2011). Children's step counts on weekend, physical education, and non-physical education days. Journal of Human Kinetics, 27, 123–134.

Brusseau, T. A., Kulinna, P. H., Tudor-Locke, C., & Ferry, M. (2013). Daily physical activity patterns of children living in an American Indian community. Journal of Physical Activity and Health, 10, 48-53.

Brusseau, T. A., Tudor-Locke, C., & Kulinna, P. H. (2013). Are Children Meeting Any of the Suggested Step Recommendations? Biomedical Human Kinetics, 5, 11-16.

Burns, R. D., Brusseau, T. A., & Hannon, J. C. (2015). Effect of a Comprehensive School Physical Activity Program on School Day Step Counts in Children. Journal of Physical Activity & Health. Epub ahead of print DOI: http://dx.doi.org/10.1123/jpah.2014-0578

Carlson, S. A., Fulton, J. E., Lee, S. M., Maynard, L. M., Brown, D. R., Kohl III, H. W., & Dietz, W. H. (2008). Physical education and academic achievement in elementary school: data from the early childhood longitudinal study. American Journal of Public Health, 98(4), 721.

Castelli, D. M., & Beighle, A. (2007). The physical education teacher as school activity director. Journal of Physical Education, Recreation & Dance, 78(5), 25-28.

Centers for Disease Control and Prevention (2013). Comprehensive School Physical Activity Programs: A Guide for Schools. Atlanta, GA: U.S. Department of Health and Human Services.

Centers for Disease Control and Prevention (2012). Parent engagement: strategies for involving parents in school health. Atlanta, GA: U.S. Department of Health and Human Services; 2012.

Centers for Disease Control and Prevention (2011). School health guidelines to promote healthy eating and physical activity. MMWR, 60, 28–33.

Chaddock, L., Hillman, C. H., Buck, S. M., & Cohen, N. J. (2011). Aerobic fitness and executive control of relational memory in preadolescent children. Medicine & Science in Sports and Exercise, 43(2), 344-9.

Colley, R. C., Janssen, I., & Tremblay, M. S. (2012). Daily step target to measure adherence to physical activity guidelines in children. Medicine & Science in Sports and Exercise, 44(5), 977-982.

Cullen, K. W., Baranowski, T., Baranowski, J., Hebert, D., DeMoor, C., Hearn, M. D., & Resnicow, K. (1999). Influence of school organizational characteristics on the outcomes of a school health promotion program. Journal of School Health, 69(9), 376-380.

Darst P. W., Pangrazi, R. P., Brusseau, T. A., & Erwin, H. (2015). Dynamic Physical Education for Secondary School Students (8th ed.). Benjamin Cummings: San Francisco.

Deckelbaum, R. J., & Williams, C. L. (2001). Childhood obesity: the health issue. Obesity Research, 9(S11), 239S-243S.

Donnelly, J. E., & Lambourne, K. (2011). Classroom-based physical activity, cognition, and academic achievement. Preventive Medicine, 52, S36-S42.

Erwin, H. E., Beighle, A., Morgan, C. F., & Noland, M. (2011). Effect of a Low-Cost, Teacher-Directed Classroom Intervention on Elementary Students' Physical Activity. Journal of School Health, 81(8), 455-461.

Escalante, Y., García-Hermoso, A., Backx, K., & Saavedra, J. M. (2014). Playground designs to increase physical activity levels during school recess a systematic review. Health Education & Behavior, 41(2), 138-144.

Goh, T. L., Hannon, J. C., Brusseau, T. A., Webster, C., Podlog, L., & Newton, M. (2014). Effects of a classroom based physical activity program on children's physical activity levels. Journal of Teaching in Physical Education, 33, 558-572.

Kohl III, H. W., & Cook, H. D. (Eds.). (2013). Educating the student body: Taking physical activity and physical education to school. National Academies Press.

Kulinna, P. H., Brusseau, T. A., Cothran, D. J., & Tudor-Locke, C. (2012). Changing School Physical Activity: An Examination of Individually School Designed Programs. Journal of Teaching Physical Education, 31, 113-130.

Larson, J., Brusseau, T. A., Chase, B., Heinneman, A., & Hannon, J. C. (2014). Youth Physical Activity and Enjoyment during Semi-Structured versus Unstructured School Recess. Open Journal or Preventive Medicine, 4, 7.

Lee, S. M., Burgeson, C. R., Fulton, J. E., & Spain, C. G. (2007). Physical education and physical activity: results from the School Health Policies and Programs Study 2006. Journal of School Health, 77(8), 435-463.

Lee, S. M., Nihiser, A., Strouse, D., Das, B., Michael, S., & Huhman, M. (2010). Correlates of children and parents being physically active together. Journal of physical activity and health, 7, 776-783.

Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., & Katzmarzyk, P. T. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. The Lancet, 380(9838), 219-229.

Mahar, M. T., Murphy, S. K., Rowe, D. A., Golden, J., Shields, A. T., & Raedeke, T. D. (2006). Effects of a classroom-based program on physical activity and on-task behavior. Medicine and science in sports and exercise, 38(12), 2086.

National Association for Sport and Physical Education and American Heart Association (2006). 2006 Shape of the Nation Report: Status of Physical Education in the USA. Reston, VA: National Association for Sport and Physical Education.

National Association for Sport and Physical Education (2008). Comprehensive school physical activity programs. Reston, VA: National Association for Sport and Physical Education.

Ogden, C. L., Carroll, M. D., Curtin, L. R., McDowell, M. A., Tabak, C. J., & Flegal, K. M. (2006). Prevalence of overweight and obesity in the United States, 1999-2004. Journal of the American Medical Association, 295(13), 1549-1555.

Osilla, K. C., Van Busum, K., Schnyer, C., Larkin, J. W., Eibner, C., & Mattke, S. (2012). Systematic review of the impact of worksite wellness programs. The American journal of managed care, 18(2), e68-81.

Pangrazi, R. P., Beighle, A., & Pangrazi, D. (2009). Promoting physical activity and health in the classroom. Pearson Education, Inc. San Francisco: CA.

Pellegrini, A. D., & Bjorklund, D. F. (1997). The role of recess in children's cognitive performance. Educational Psychologist, 32(1), 35-40.

Ramstetter, C. L., Murray, R., & Garner, A. S. (2010). The crucial role of recess in schools. Journal of School Health, 80(11), 517-526.

Salcedo Aguilar, F., Martínez-Vizcaíno, V., Sánchez López, M., Solera Martínez, M., Franquelo Gutiérrez, R., Serrano Martínez, S., ... & Rodríguez-Artalejo, F. (2010). Impact of an after-school physical activity program on obesity in children. The Journal of Pediatrics, 157(1), 36-42.

Sallis, J. F., McKenzie, T. L., Kolody, B., Lewis, M., Marshall, S., & Rosengard, P. (1999). Effects of health-related physical education on academic achievement: Project SPARK. Research Quarterly for Exercise and Sport, 70(2), 127-134.

Strong, W. B., Malina, R. M., Blimkie, C. J., Daniels, S. R., Dishman, R. K., Gutin, B., ... & Trudeau, F. (2005). Evidence based physical activity for school-age youth. The Journal of Pediatrics, 146(6), 732-737.

Tremblay, M. S., & Willms, J. D. (2003). Is the Canadian childhood obesity epidemic related to physical inactivity?. International journal of obesity, 27(9), 1100-1105.

Trost, S. G., Rosenkranz, R. R., & Dzewaltowski, D. (2008). Physical activity levels among children attending after-school programs. Medicine & Science in Sports and Exercise, 40, 622-629.

Tudor-Locke, C., Craig, C. L., Beets, M. W., Sarahjane, B., Cardon, G. M., Duncan, S….& Blair, S. N. (2011). How many steps/day are enough? For children and adolescents. International Journal of Behavioral Nutrition and Physical Activity, 8, 78.

U.S. Department of Health and Human Services (2012). Physical Activity Guidelines for Americans Midcourse Report: Strategies to Increase Physical Activity Among Youth. Washington, DC: U.S. Department of Health and Human Services.

U.S. Department of Health and Human Services (2008). Physical activity guidelines advisory committee report. Washington, DC: U.S. Department of Health and Human Services.

Williams, S. M., & Hannon, J. C. (2013). Physical Education Homework That Involves the Family. Strategies, 26(3), 3-8.

International Electronic Journal of Elementary Education, 2015, 7(3), 451-468.

The Effect of Cooperative Learning on Students' Achievement and Views on the Science and Technology Course

Sertel ALTUN *
Yildiz Technical University, Turkey

Received: 10 December 2014 / Revised: 2 May 2015 / Accepted: 22 May 2015

Abstract

The purpose of this study is to investigate the efficiency of learning plan implementation prepared with the cooperative learning method. In particular, the study addresses the effect of cooperative learning on students' achievement and their views regarding the 'Systems in Our Body' unit of the 6th grade Science and Technology lesson. For this purpose, mixed method was used. The study is conducted in the second term of the 2013-2014 academic year, on a study group consisted of 7 girls and 13 boys, a total of 20 students of a private middle school in Istanbul. An achievement scale was utilized for the quantitative data and focus group interviews were hold for the qualitative data. While t-test was used for the quantitative findings, content analysis technique was used for the qualitative data. The result of the study indicated that CL method had a favorable effect on learning. The cooperation based learning-teaching environment provided cooperation, supported permanent learning, provided opportunities to be successful, contributed to the development of social and personal skills, but also caused worry as it requires students to be successful at all stages.

Keywords: Cooperative learning, science and technology, achievement, student view.

Introduction

In the era what we call information society, one of the most important skills is cooperation. In early days, studying with someone else was defined as an indicator of dependency, but today learning together and asking for help is considered among the best strategies for learning to learn (Chen, 2002). Producing information, theorizing or developing models in a field requires more complicated information and skills. Therefore, common mind is better than the single best mind. The common mind is more effective for the mentioned novelties or, in other words, in creating acceptable change in society. All the systems from health to economics, law to education, information industry to the service industry consider cooperative working among priorities in order to keep up with the times and make a difference in the society. The output of the education system provides the labor force input for other systems. For this reason, the efficiency and

* Sertel ALTUN, Yildiz Technical University, Faculty of Education, sertelaltun@gmail.com

ISSN:1307-9298

www.iejee.com

productivity of the education system is proportional to its ability to raise the desired labor force for other systems. Under these circumstances, cooperative working habit should be brought in to students at all levels of education systems (Slavin, 1987; Johnson & Johnson, 1999).

Cooperative learning cannot be taught through verbal instruction. Students can adopt cooperative learning through a process that involves working together in groups, developing a product at the end and examining both the product and cooperative learning skills. "Cooperative learning" (CL) method emerges in the literature as a method that assists instructors in carrying out this process. CL emerges when students gather in order to reach a common goal (Johnson & Johnson, 1999). Each member of the group reaches his goal only if all the other members reach their own learning goals (Deutsch, 1962). Acikgoz (2002) defines cooperative learning as working of students in small groups and helping each other in the learning process.

There are certain principles and requirements for the implementation of CL. These are;

- Positive Interdependence: Each individual depends on the other members of the group. Each individual complements others.
- Individual Accountability: Individual accountability is the evaluation of each individual's performance and effect of the result on individual and group success.
- Face to face interaction: Group members reach success by helping each other and sharing ideas. As face to face interaction increases in this process, the sense of responsibility and social solidarity increases.
- Social Skills: As the students are in a group in the cooperative learning, they acquire social skills better.
- Evaluation of the Group Processing: At the end of the group work, students gather and discuss the productivity of the project and whether they have reached the goals (Johnson & Johnson, 1999; Johnson, Johnson & Smith, 1998).

What makes CL strong in the literature is its strong theoretical foundation. The method is based on Bandura's Social Dependency Theory, Behavioral Learning Theory (Johnson, Johnson & Smith, 1998) and Vygotsky's (1978) "Zone of Proximal Development" theory. Social Dependency Theory assumes that the way to form social dependency is about how social dependency develops, how individual interacts and what the result will be as a result of the interaction. Accordingly, positive interdependence (cooperative approach) results in such an interaction that the group members encourage, support and improve the efforts of the individuals. Behavioral Learning Theory focuses on the effect of group consolidation and rewards on learning. According to this theory, behaviors, which are rewarded externally, are repeated. While, Skinner (1985), one of the representatives of behavioral cult, focuses on the group coincidences, Bandura focuses on the imitation. Slavin (1987) has recently stated that external "group awards" are needed in order to motivate the individuals to learn in groups based on cooperative learning (Saban, 2005). According to the Vygotsky's Zone of Proximal Development Theory, a student can take his/her learning to the optimum level by asking for help when he/she is stuck. The person to whom he asks for help may be his/her teacher or friend.

It has been found out that CL has important effects on improving academic success of students (Hall, 1988; Tarim, 2003; Kolawole, 2007; Gok. Dogan, Doymus & Karacop, 2009; Ahmad & Mahmood, 2010, Capar, 2011; Parveen & Batool, 2012), developing desirable attitudes toward courses (Yavuz, 2007), providing motivation (Nichols & Miller, 1994; Margolis & McCabe, 2003; Salili & Lai, 2003; Kus, Filiz & Altun, 2014; Yoshida, Tani, Uchida, Masui & Nakayama, 2014;), adopting cooperative working habit (Rienties, Tempelaar, Bossche, Gijselaers & Segers, 2009), and improving favorable competition skills (Kong, Kwok & Fang, 2012) in studies from different fields.

Although there are many techniques in CL, Jigsaw and Team Game Tournament (TGT) techniques were used in this study. Jigsaw technique was developed by Aronson (2000). Students are divided into groups of 5-6 members in this technique. Each member works on his subject and students from different groups working on the same subject gather and create expert groups. The subject is discussed in depth in the expert groups. Students learn the subject completely in the expert groups and teach their subject to other students when they return to their original groups. Even if the students are graded individually, students need others for a good mark and therefore this technique requires cooperative working (Slavin, 1987; Arends, 1998; Aronson, 2000; Senemoglu, 2012). TGT technique was developed by Slavin and Oickle (1981). After the teacher or students make the presentation related to the courses, students are divided into heterogeneous groups in this technique. After the students teach the subject to each other, students compete with the students at the same level from other groups at the tournament table. The team points are calculated by summing the points of students. The groups with high points are rewarded (Slavin, 1995; Arends, 1998).

It is stated that individuals have benefited from Science and Technology instruction in using these scientific process and principles for decision-making and in participating in scientific discussions affecting the society and developing their skills to producing ideas on a subject (Akcay & Yager, 2010). According to another approach, Science and Technology instruction is an easy and tangible instruction that should be conducted with proper method and techniques by taking the interests, needs, level of development, desires and environmental facilities of students (Hancer, Sensoy & Yildirim, 2003). As can be understood from the explanations, for an effective Science and Technology instruction, students' sense of curiosity should be enhanced and an active environment in which students can discover and produce information should be created. The complicated structure of the Science and Technology course requires cooperation for students to learn the subjects (Yagcı, Kaptı & Beyaztas, 2012). Moreover, implementation of cooperative learning method in the Science and Technology classes is advised by the Ministry of National Education (Ministry of National Education, 2005).

It is thought that the use of a learning plan prepared in line with CL in the Science and Technology instruction provides students with more efficient thinking and problem-solving skills and cooperative working habit, develops students cooperation skills, enables them to present more extensive studies by making use of their shared experiences and supports long-lasting learning by supporting peer learning. For this reason, the efficiency of CL implementation in teaching "Systems in our Body" unit is evaluated in this study.

In this context, the purpose of the study is to determine the effects of teaching "Systems in Our Body" unit of Science and Technology course through CL method on students' achievement and their view regarding the course. The research questions are:

1- Is there a significant difference between the pre-test and post-test scores of students who studied the systems in our body unit of Science and Technology course based on cooperative learning method?
2- How do students' views on the systems in our body unit of Science and Technology course change through the cooperative learning method?

Method

Research Design

In this study, explanatory design, which is one of the mixed method designs, was used where qualitative and quantitative methods were gathered. The purpose of this two stage design is to support, explain, or exemplify data collected through quantitative and qualitative methods (Creswell, 2012). As for this study, in order to determine the effect of CL method on students' achievement, pre and post-tests before and after the implementation of cooperative learning in the course were applied. Then in order to support and explain the findings of the tests, focus group interviews were conducted so as to clarify the effect of CL method in this course from the students' points of view.

The following steps were followed for the study:

- Before the application of the learning plan, the researcher got demographical information about the students and made observations in the classroom. The researcher attempted to receive information related to the teaching practices of the instructor within the scope of Science and Technology course.
- The learning plan which was prepared by the researcher was examined by the instructor. Unclear parts were revised by taking the opinions of the instructor into consideration. This way, the plan was reconsidered and finalized by both the instructor of the course and the researcher.
- Students were informed about the practice.
- The achievement test prepared within the scope of the study was applied as a pre-test to the students.
- The practice took four weeks (16 class hours). The researcher evaluated the implemented program's suitability with the principles of teaching design by making observations during the implementation process. The lessons were not taught by the researcher, it was taught by the Science and Technology instructor of the school where the study was conducted. The instructor and the researcher held reflection meetings during the implementation process, in which the failing or unclear points were determined and the next class hour proceeded accordingly.
- At the end of the practice, the achievement test was applied as a post-test to the students and focus group interviews were carried out with 10 volunteers.

Participants

The research was carried out in a private school situated in Kartal district of İstanbul. The instructor of Science and Technology course applied CL method to the 6th grade students. The researcher took on the observer role in the study. The students were 20 in total, as 7 girls and 13 boys. The mean age of students was 12.

Data Collection Tools and Data Collection

In order to define the problem in detail and present possible solutions, quantitative data was collected from the achievement test and qualitative data was collected from the focus group interviews by taking the research question into consideration.

Achievement Test. The achievement test associated with the "Systems in our Body" unit was developed in order to collect quantitative data. The following method was followed while developing the achievement test: Firstly, a table of specifications was prepared and 50 test points was written in this context in order to determine the gains and topics that the achievement test measures. As the content validity of the test is mostly based on the expert opinions (Baykul, 2000), expert opinions were used to determine the extent and face validity of the assessment instrument. The table of specifications and the test were given to the three Science and Technology instructors who were working at the secondary school and completed five years in their careers. Three Turkish instructors were consulted in order to determine whether the points were clear or not and whether there were any grammatical mistakes. Moreover, expert opinion was taken in terms of methodological suitability of the points. In this context, four academicians working at the department of Curriculum and Instruction, and Science Education of the Faculty of Education were consulted. In line with the expert opinions, a pilot form was prepared by excluding 10 points which were either not clear or did not have the capacity to test the expected competency. The pilot form consisting of 40 points was applied to 16 boys and 18 girls, a total of 34, 7th grade students studying at a secondary school at the Besiktas district of İstanbul province as part of the pilot study. The reason of practicing the pilot study on 7th grade was to have the students who had already learned the subject. Item and test analysis of the collected data were conducted, item discrimination index, item difficulty index and average difficulty of the test values were checked (Baykul, 2000). As a result of the analysis, 10 points whose item discrimination value was below 0.30 were removed from the test. By considering the allocation of points to the sub-learning fields, 5 points whose item discrimination index were between 0.30 and 0.58 were removed from the test. Thus, 25 item remained in the final form of the test. Average difficulty of the test was determined as 0.45 by the item difficulty test. As can be seen, the test has medium level of difficulty. Buyukozturk (2004) states that reliability is associated with how accurate the assessment instrument assesses the desired feature. The reliability of a test is determined by the correlation coefficient, which explains the degree of association between the real and observed points acquired from a scale. As a result of the analyses, KR-20 reliability coefficient of the scale consisting of 25 items was calculated to be 0.76. This value is at an acceptable level according to Linn and Gronlund (2005).

Focus group interview. Focus group interview was used in order to collect qualitative data for the study. Focus group interview is an unstructured meeting between a small group and a leader and using the effect of group dynamic in the planned discussion to collecting detailed information and produce ideas (Bowling, 2002). Interview questions were evaluated by one field expert and two experts from the Curriculum and Instruction department for validity and reliability. Validity of the interview questions were held in the following way: First, I determined the interview questions based on the cooperative learning principles asserted by Johnson and Johnson (1999). Then, these interview questions were examined by two experts in Curriculum and Instruction Department. The final version of the questions was constructed by taking the expert's opinions into account. Then, student volunteers were selected. As a result, 10 students were taken to the interview. For the reliability of the interviewing process, I interviewed the same focus group twice at different times. In both sessions, students were interviewed equally with the same questions. The main questions asked were: "What are the advantages of CL method?"; "What skills did you acquire through CL method?", "What are disadvantages of the method?" The first focus group interview took 90 minutes and the other one a week later took 60 minutes. The researcher and reporter took notes in the data collection process. Moreover, all the interviews were recorded. Later, all recordings were transcribed verbatim.

Process

Prior to the determination of the unit of research, both the researcher and the instructor of the course worked on the aforementioned principles of the CL method. Then, they both decided that the systems in our body unit would be appropriate to use CL method. Following, the general purpose of the learning plan was determined as " Students' comprehending the functions of support and movement, circulatory, respiratory, lymphatic and immune systems in the body, the health of these systems and the effects of technological developments on treating the health problems related to these systems" by taking the National Curriculum for Science and Technology course.

Planning: While determining the content, the main concepts and rules related to the topics were determined in line with the teaching guidelines principle of CL. Jigsaw and tournament techniques of CL were used in teaching these main concepts and rules.

Warm-up: Students were divided into four heterogeneous (according to the gender and success levels) groups consisting of five students at this stage. In order to ensure group dynamics of students, the first two classes were dedicated to warm-up activities. Warm-up involves a problem which should be solved by the groups. Groups have to be in contact and develop strategies in order to solve the problem. At this stage, students' ways of communication, motivations, group dynamics and strategy development were noted by observer. When all groups finished working, self-evaluations of students were taken and the instructor gave feedback. In this process, the aim was to let students realize the important points related to the team awareness.

Teaching of the Lesson: The next stage is the teaching of the subject. Firstly, the jigsaw technique of the CL method was applied. Each member of the group was given one of the following subjects: "support and movement system", "circulatory system", "respiratory system", "lymphatic system" and "immune system". Firstly, each member of the group was given an individual worksheet during the class. Basic information, classifications, examples and tasks of the given system were included on the work sheet. Students worked individually for two classes. Later, the question based worksheet prepared by the researcher was filled by the students. At the next stage, students with the same subjects from different groups gathered and started expert group study. For example, all students who had the "circulatory system" subject gathered. Students shared the question based worksheet which they answered among each other and created a common answer sheet. Then, the instructor gave the expert group another worksheet with advanced information on the subject. The content of the mentioned worksheet consisted of relationship of the subject with other systems and its function in terms of body health. The mentioned stage lasted for two class hours. Then, students returned to their groups and each of them told what they learnt about their subjects to their friends. Then, groups came together and prepared poster and presentation work on all the subjects. This stage took four class hours. Then, groups made their presentations in order in two class hours. The instructor took self-evaluation from the group members and expressed his observations. Then, the instructor explained the "lymphatic and immune system" subject which was not completely understood by the students with the help of a computer presentation program. The tournament technique which was already explained to the students took place in the last two hours. In this process, 4 tables were formed in the classroom and one student from each group went to the tables to represent their groups. The instructor asked each student a different question related to the subject and the student who knew the answer earned the points for his/her group. Then, another student from his/her group came. The student from the other group had to stay at the table until he/she knows the answer. The team which completed the tournament first (the team all members of which came to the table and knew the answers) became the first. They were rewarded with pizza which was bought by the money collected from other groups.

Evaluation: Written or verbal reflection of the students on their own learning process and the teaching process at the end of each class were taken and evaluated for the evaluation aspect of the learning plan. The feedback of the students was evaluated, the next class plans were revised by the instructor and the researcher and necessary changes were made. At the same time, while students were working in their groups, they were observed and directed by the instructor. The worksheets of students were collected by the instructor at the end of the class and given back to the students at the next class after the necessary revisions were conducted. In addition to the worksheets, the products produced by the students were evaluated in terms of whether they reached the expected goals. Throughout the process, as Johnson and Johnson (1999) and Johnson, Johnson and Smith (1998) recommend, each student evaluated himself and each other through verbal expressions and daily written reflections in the cooperative skill development, presentation, and tournament activities and the instructor evaluated the students, as well.

Data Analysis

T-test was conducted for the participant students to compare the points obtained from pre-test and post-test, and SPSS 16.00 program was utilized for the analysis of data.

The qualitative data acquired from the focus group discussions was interpreted through content analysis. The process of content analysis consists of the classification of data acquired from the interviews and determining main concepts and codes (Creswell, 2012). In this regard, transcripts of each of the student's answers to the relevant questions were read line by line by the researcher. The classification of the students' relevant answers was done by taking CL principles into consideration as Slavin (1987) and Johnson and Johnson (1999) recommended. Then, the themes were created by clustering the most repeated expressions together. Then, the codes representing the themes were determined. In the analysis process, one field expert and two experts from the Curriculum and Instruction department were asked to challenge the plausibility of the themes and the codes in regards to the data (see Table 2).

Results

Results Related to the First Question of Research

The first question of the research is "Is there a significant difference between the pre-test and post-test scores of students who studied the systems in our body unit of Science and Technology course based on cooperative learning method?" The results of t-test which was conducted in relevant groups to determine whether there is a significant difference between pre-test and post-test success grades are given in Table1.

Table 1. *T-test results of pre-test and post-test*

Gender	*N*	*M*	*sd*	*t*	*p*	*d*
Pre-test	20	52.40	14.38	7.50	.00**	1.68
Post-test	20	76.20	9.83			

** $p<.01$

When Table 1 is examined, the average pre-test achievement of is found to be 52.40 and the average post-test success is found to be 76.20. As the p value is lower than .01 which determine the significance level, the difference between the pre-test and post-test is statistically in favor of the post-test (t=7.50; p<.01). The effect value is determined with the Cohen d and it is found as 1.68. This value notes that the effect value is high as it is greater than 0.80 (Stevens, 1996: 174). Therefore, it can be said that CL had a favorable effect on students' achievement in the Science and Technology class.

Results Related to the Second Question of Research

The second question of the research is "How do students' views on the systems in our body unit of Science and Technology course change through the cooperative learning method? ". Six themes were established, namely "formation of cooperative environment", "creation of success opportunities", "supporting permanent learning", "developing a sense of responsibility ", "emergence of different skills", "necessity to be successful" as a result of the data content analysis acquired from the focus group interviews with students. The following code indicates which citation belongs to which student: The students are coded as first student (S1), second student (S2), third student (S3), fourth student (S4), fifth student (S5), sixth student (S6), seventh student (S7), eighth student (S8), ninth student (S9) and tenth student (S10). "Themes, codes and definition of codes" acquired from the student views are given in Table 2. The data is presented in detail.

Table 2. "Themes, codes and definition of codes" extracted from student views

Questions	Themes	Codes	Definition of Codes
What are the advantages of cooperative learning method in the teaching process?	*Formation of Cooperative Environment*	Interaction	Students have to work together in order to produce a product and be successful in the tournament
		Unity of Purpose	Everybody should work for a common purpose
		Peer contribution	All members of the group have to be successful for a group to be successful. Group members should help each other learn in order to make up for deficiencies

Table 2. (cont.) "Themes, codes and definition of codes" extracted from student views

Questions	Themes	Codes	Definition of Codes
What are the advantages of cooperative learning method in the teaching process?	*Creation of Success Opportunity*	Multitude of opportunities	There is no need to be successful only in the exams to be considered successful. Providing success opportunities in information transfer, presentation and tournament
		Favorable effect of the group on the individual	In order to be successful, the team is required to be successful. Even if an individual is not successful, the team members should support him for the team success
	Supporting Permanent Learning	Activeness	The student should be kept active in this process
		Repetition opportunity	Teams have the opportunity to repeat the same subjects in different forms and activities
		Peer learning	Students have the opportunity to learn from each other

Table 2. (cont.) "Themes, codes and definition of codes" extracted from student views

Questions	Themes	Codes	Definition of Codes
Which of your skills developed through the cooperative learning method in the teaching process?	*Developing a Sense of Responsibility*	Individual role	Giving each member a role from the beginning to the end and raising a sense of responsibility by expressing that if a member does not fulfill their role, the group will be affected unfavorably
		Team success	The student's inclination to fulfill his responsibility in a timely manner in order not to pose a problem to the team
	Presenting Different Skills	Leadership	Motivating team, use of expected skills at maximum level and coming to the front of the group leaders for crisis management
		Teaching	The emergence of students' teaching skills especially in the expert group studies and group sharing
		Presentation	Ensuring group success through effective presentation
What are the disadvantaged of the CL method?	*Necessity to be Successful*	Tournament	Because the team members do the teaching, the other team members' learning depends on the effectiveness of the teaching
		Expression	The questions in the tournament is directed to the individuals rather than the team. Thus, even if one of the team members is not good at answering the questions, the team can not win the tournament

The advantages of the cooperative learning method in the learning-teaching process:

Formation of Cooperative Environment: The students emphasized that the cooperation was very important in the cooperative learning environment during the lectures, presentations, and tournament. The students expressed that they had been in touch with the same students, but they had not even cooperated with their friends in previous classes. Hence, in this method, they had the opportunity to be in touch with different friends and learnt how to study cooperatively. In addition, students emphasized that in order to be more successful than other teams, they motivated their weak friends and corrected their deficiencies while getting ready for the tournament for the team success as all members were required to be successful. Moreover, students said that there was a common purpose in this process and the success of team members affected the team success. Therefore everybody had to work cooperatively to be successful. The student views in accordance with relevant codes are given below:

> "...In the past, I did not have any contact except saying hello to two members of my group. However, now I can say that I have had more opportunities with these two friends for

cooperation than my close friends. Moreover, helping these two friends and asking for help from them made me feel happy." (S1, interaction)

"…. I was not ready enough for the tournament. But, my group members helped me and I gained points for my group by answering the questions in the tournament. However, if I were alone in the tournament and my friends did not help me, I would not be successful." (S4, peer contribution and unity of purpose)

"....In order to be successful in presentation and tournament, we always asked questions to each other. We even asked questions to each other on phone and Facebook." (S7, interaction and unity of purpose)

Creation of a Success Opportunity: Students stated that as they were expected to be successful in different fields in this process, everybody had the opportunity to present themselves in line with their own skills. In addition, students emphasized that they had the opportunity to express themselves in different fields according to their own interests and skills. Also, they stated that there was not just one criterion for success, where different criteria existed for success in this approach and this created a fairer environment. It thus helped students to feel better. Moreover, the students expressed they realized that it was not enough to know the information to be successful; conveying the information properly, motivating friends, and working cooperatively were also important. The views in accordance with relevant codes are given below:

"...As there were different activities, all of us had the chance to be successful according to our skills. For example, S4 was excited in the presentation but he was very successful in the tournament." (S1, multitude of opportunities)

"....I saw that my friends were successful in different fields. We saw that those who were generally better in the exams were less successful in the tournament and those who were worse in the exams were more successful in the tournament. It made me feel happy to see that everybody could be successful at any time." (S5, multitude of opportunities)

"...I could not join the second class as I was ill. My group friends helped me study in order to be successful in the tournament." (S10, favorable effect of the team on individual).

"....There were different activities to present ourselves in this class. For example, one of the group members was conveying information very well, another was preparing very good posters, another was snappy in the tournament, and all of them were successful." (S9, multitude of opportunities)

Supporting Permanent Learning: Students expressed that they had the opportunity to learn the subject from their friends in addition to the instructor and this situation had a favorable effect on learning the subject. Students emphasized that learning subjects from their friends were much easier. Moreover, they mentioned that they had the opportunity to recap the subject a few times in the same process. Hence, as the students had the opportunity to study the subject on their own, teach it to their friends, present it and use it in the tournament, permanent learning was ensured. The views in accordance with relevant codes are given below:

" .... I studied this subject in the fifth grade but I did not learn it. My friend illustrated the subject so well that I understood it better. Moreover, I understood the related subjects better." (S3, peer learning)

"...We had the opportunity to learn the subject more permanently as we recapped the subject over and over again in different activities." (S2, repetition)

"...We were active at all stages of the class. We studied the subject, told it to our friends, prepared a presentation and competed. We learnt the subject because we were active." (S7, activeness)

"...Learning from the instructor sometimes makes the subject more difficult. On the other hand learning from a friend is much easier." (S4, peer learning)

Information and skills adopted through the cooperative learning method in the learning-teaching process:

Developing a Sense of Responsibility: Students emphasized that their responsibilities were clearer compared to the previous classes. They expressed that responsibilities of each student was clear at all stages of the process, and as the success of members affected the team success, team members become a pressure point in fulfilling the individual responsibilities. Furthermore, students expressed that they were more careful in fulfilling their responsibilities in order not to be isolated from the group. The views in accordance with relevant codes are given below:

"...We all had roles from beginning to the end. The instructor was always reminding us our responsibilities. We were required to fulfill our responsibilities in order to understand the subject, be successful in the presentation and the tournament." (S10, individual role and team success)

"...Everybody had a role. I fulfilled my responsibility in order not to be ashamed as it was clear who did not fulfill his responsibility." (S9, individual role)

"...Not only our teachers but also our friends got angry with us when we did not fulfill our responsibilities." (S1, team success)

Presenting Different Skills: Students explained that there were different activities in this process and different skills were required in order to be successful. They expressed that leadership skills were important in terms of managing the team, motivating friends, and solving problems. Students stated that different ones came to the frontline in this practice. While, certain students were at the front earlier, not only those who got higher grades but also others came to the front with this practice. Students mentioned that expressive skills, poster preparation skills, and presentation skills were very important in order to be successful in groups. The views in accordance with relevant codes are given below:

"..The most important factor in becoming a successful group was our group leader. He motivated us, directed our friend who did not fulfill his responsibilities and most importantly he made us believe that we were going to be successful. The groups without a leader were not successful." (S3, leadership)

"...Earlier, the same persons always got the reward in the class. Those who got higher grades in the exams were favorites of the class. However, we saw in this practice that those who were leaders and motivated us had important skills and they were important for our success. The best thing was that these students were different." (S6, leadership)

" ...My ideas about Ö2 changed. I was thinking that he was very passive in the classroom. The illustrations and examples he used while telling about the subject impressed me. He was explained the subject very well." (S7, teaching)

"...I explain the subject to myself very well at home, but when the teacher asks me I get excited. In this practice, explaining the subject in the group did not make me excited. My friends like how I talk. This study increased my motivation." (S2, teaching)

"...We would not be successful if we could not present it well, no matter how well prepared we were. Everyone like the presentation of the second group because their presentation skills were very good. They talked just like anchorpeople. They did not get excited, they gave examples, let us speak and they were smiling." (S8, presentation)

The disadvantages of the cooperative learning method in the learning-teaching process:

Necessity to be Successful: Students expressed that in order for this practice to be productive, all students should be successful and the subject should not be very difficult. They stated that in order to be successful, students should master the subject and have good communication among them. It was found out that even one unsuccessful student affected the team success and this situation could create unfavorable pressure on the student. Additionally, students mentioned that no matter how well the students knew the subject, insufficient communication skills affected the team success. On the other hand, students emphasized that they worried a lot about being successful in order not to be isolated from the group and face others' negative attitude. The views in accordance with relevant codes are given below:

"…This practice is nice but we all have to be successful in the group. If one of us is not successful in the tournament, the team is not successful." (S4, tournament)

"...I would like successful students to be in my group in this practice. Even if I were successful, I would be considered unsuccessful if other students in my group were not successful." (S3, expression)

"...I saw that more relaxed groups were more successful in the presentation and tournament. Being relaxed and having good communication skills are as important as studying." (S6, expression)

"...I studied hard in order not to be unsuccessful in the tournament. But I could not answer the question, because I was excited. My group got angry with me. Yet, if I were unsuccessful in an exam, nobody would get angry with me." (S8, tournament)

"...I do not think that this is a good way to teach difficult subjects. Because, we cannot tell it as well as our instructor. We should use this practice in easy subjects." (S7, expression)

Conclusion

In this study in which CL method was used in the teaching of "Systems in our Body" unit of Science and Technology course, it was found out that CL method had a favorable effect on making the relevant gains. The cooperation based learning-teaching environment of the study provided cooperative learning environment, supported permanent learning, provided opportunities to be successful, contributed to the development of social and personal skills, but caused students to worry as it requires students to be successful at all stages.

Discussion

Based on the achievement test applied within the practice and the student views, it is seen that cooperative learning had a favorable effect on learning of students. The reasons behind this situation can be explained in two ways. First, CL strategies are based on repetition to support permanent learning. Students had the opportunity to recap the subject at different stages in the CL process. In the individual studying, they attempted to learn the subject themselves, then discussed the subject with their friends in depth and recapped the subject in order to present it. Finally, their studies to be successful in the tournament and their performances and learning process in the tournament could have contributed to their understanding of the subject. The second factor is Vygotsky's "Zone of Proximal Development" construct. Vygotsky's "ZPD" concept refers to the distance between the current development level of independent problem solving skills and the potential development level of problem solving skills with cooperation with a more skillful peer or under the supervision of an adult (Vygotsky, 1978). CL process supports peer learning. All individuals have to be successful in order for the group success. Therefore, students corrected other team members' deficiencies. The relevant studies support this finding (Hall, 1988; Slavin, 1995; Kolawole, 2007; Gok, Dogan, Doymus and Karacop, 2009; Ahmad and Mahmood, 2010, Parveen and Batool, 2012).

Another finding obtained from the participants is that CL environment creates a cooperative working environment. Cooperative learning involves working together for a common purpose and creates a rich teaching-learning environment in terms of student interaction (Arends, 1998). Students emphasized that "the difference of this practice from the teacher-centered processes is that studying together is more important to be successful rather than studying alone". Granier, Dyson and Yeaton (2005) stated in their relevant study that CL is the method which provides interaction among students at the maximum level. Studies of Rienties, Tempelaar, Bossche, Gijselaers and Segers, (2009) supports this finding.

Students mentioned that one of the most important advantages of the CL is that there are many opportunities to be successful. While the success indicator is grades in the traditional learning environment, there are many success indicators in the CL environment and this situation relaxed the students from an affective point of view. One of the students stated that "there were different activities to present ourselves in this class. For example, one of the group members was conveying the information very well, another was preparing very good posters, another was snappy in the tournament, and all of them were successful (S9)". It was observed that some students were successful in presentation, some were good at poster preparation and some were good at the tournament. Students have the opportunities to be successful according to their interests and skills in this environment. Senemoglu (2012) states that as CL requires contributions of each individual at different stages, it helps students to develop a sense of self-esteem and self-efficacy.

Another finding obtained from the participants is that CL environment contributes to the emergence and development of students' social and affective skills. Students stated that "our friends who were passive before came to the front with leadership, teaching and presentation skills in this practice (S7, S9)". The root cause of this situation can be explained as follows: In order to be successful in the teacher-centered environments, students have to listen to the teacher carefully and study hard. However, in order to be successful in this practice, students have to study the subject, have good teaching skills in order to correct others' deficiencies and have good presentation skills to present the product of the group in a desirable way and think fast and control their excitement in order to be successful in the tournament. In other words, different skills come to the front. Statements from students such as "I learned different sides of my friends in this process (S7)" and "Generally my grades were high but I understood in this practice that I had to develop my problem-solving, presentation and communication skills (S8)" indicate that they both explored different sides of their friends and discovered their own deficiencies. In a relevant study, it was found out that CL is much more effective in eliminating the prejudices among students and increasing the student success than all traditional classroom teachings (Gage and Berliner, 1998).

In the study, the disadvantage of the practice was found out to be the requirement to be successful for all group members. This situation is stated in two ways. First one is the anxiety of less successful students due to the group pressure. "I studied hard in order not to be unsuccessful in the tournament. But I could not answer the question twice, because I was excited. My group got angry with me. Yet, if I were unsuccessful in an exam, nobody would get angry with me (S9). The other kind of anxiety is the anxiety of successful students to be unsuccessful because of the less successful members of the group. "I would like successful students to be in my group. Even if I were successful, I would become unsuccessful if they were not successful (S7)" Both of these reasons caused students to have unfavorable feelings. These results might be due to the characteristics of the study group. The mentioned group consists of students who got into the private school through scholarship exams with high academic success and their teachers and parents consider academic success among priorities. Therefore, students are inclined to eliminate the unfavorable factors affecting their success. Hence, the success of the students in this process was appreciated and in case of not being successful they stated that they were faced with isolation in the group and were scolded. Moreover, in order not to be isolated from the group and face with negative attitudes, they studied hard and saw these factors as favorable pressure items: "Not only our instructor but also our friends got angry with us" . This also created anxiety in case of not being successful: "I wanted to be successful in order not to be excluded from the group and being scolded. Especially, I studied hard in order not to be unsuccessful in the tournament but my anxiety was very high (S2)".

Recommendations

The field of education may benefit from the findings of the study in various ways. Although this study is limited by only using data from one 6th grade class, the results showed that CL method creates a favorable effect on achieving social and affective skills. This suggests that CL method can be used in Science and Technology classes. In particular, the effects of CL on different units of Science and Technology classes can be investigated, and the results of this study and following studies can be compared with the effects of CL in other disciplines., Also, in order to make instructors use the method effectively, it could be integrated into both pre-service education programs and professional development workshops for in-service teachers. In addition, teacher educators could model this method in such programs. In such an integration, one issue should be taken cautiously: Possible conflicts within and between groups, which are noted in the results of this study, could require the instructors make good observations and be a guide in preventing and solving intragroup conflicts.

• • •

References

Acıkgoz, K.U. (2002). Aktif ogrenme [Active learning]. Izmir: Egitim Dunyası Yayinlari.

Ahmad, Z & Mahmood, N. (2010). Effects of cooperative learning vs. traditional instruction on prospective teachers' learning experience and achievement. Journal of Faculty of Educational Sciences, 43(1), 151-164.

Akcay, H & Yager R. E. (2010). The ımpact of a science/technology/society/ teaching approach on student learning in five domains. Journal of Science Education Technology, 19,602–611.

Arends, R.I. (1998). Learning to teach. (4th. edition). New York: Mc Graw-Hill.

Aronson, E. (2000). Nobody left to hate. The Humanist, 60(3), 17-21.

Baykul, Y. (2000). Egitimde ve psikolojide olcme: Klasik test teorisi ve uygulamasi [Measurement in education and psychology: Classical test theory and application]. Ankara: OSYM yayınları.

Bowling, A. (2002). Research methods in health: Investigating health and health services. Philadelphia, PA: McGraw-Hill House.

Buyukozturk, S. (2004). Sosyal bilimler icin veri analizi el kitabi [Data analysis manual for social sciences]. (4. Baskı). Ankara: Pegam A Yayincilik.

Capar, G.I. (2011). Isbirlikli ogrenme yonteminin ogrencinin matematik basarisi ve matematige iliskin tutumu uzerindeki etkililigi: Bir meta-analiz calismasi [Cooperative learning method's effect on student's mathematics achievement and relevant behavior: A meta-analysis study]. Cukurova Universitesi, Sosyal Bilimler Enstitusu.

Chen, C.S. (2002). Self-regulated learning strategies and achievement in an ıntroduction to ınformation systems course. Information Tecnology, Learning and Performance Journal, 20(1), 11-25.

Creswell, J. W. (2012). Educational research: planning, conducting and evaluating quantitative and qualitative research. Boston: Pearson Education, Inc.

Deutsch, M. (1962). Cooperation and trust: Some theoretical notes. In M. R. Jones (Ed.): Nebraska symposium on motivation, Lincoln, NE: University of Nebraska Press, pp. 275-319.

Gage, L. R. & Berliner, D. C. (1998). Educational research: (6th edition). Boston: Houghton Mifflin Company.

Grenier, M., Dyson, B. & Yeaton, P. (2005). Cooperative learning that includes students with disabilities: An effective teaching strategy, cooperative learning promotes student interaction, benefiting students with and without disabilities. Journal of Physical Education, Recreation & Dance, 76: 6-29.

Gok, O., Dogan, A., Doymus, K. & Karacop, A. (2009). Isbirlikli ogrenme yönteminin ilkogretim ogrencilerinin akademik basarılarına ve Fen'e olan tutumlarına etkileri [Effect of Cooperative Learning Method on Primary School Students' Academic Achievement and Attitude Towards Science]. Gazi Egitim Fakultesi Dergisi, 29 (1), 193-209.

Hall, L. E. (1988). The effects of cooperative learning on achievement: A meta-analysis. (Order No. 8910420, University of Georgia). ProQuest Dissertations and Theses, , pp. 197-197 Retrieved from http://search.proquest.com/docview/ 303657371?accountid=17384. (303657371).

Hancer, A. H., Sensoy, O. & Yildirim, H. I. (2003). İlkogretimde cagdas Fen Bilgisi ogretiminin onemi ve nasıl olması gerektigi uzerine bir degerlendirme[An assessment on the importance of modern science instruction and how it should be]. Pamukkale Universitesi Egitim Fakultesi Dergisi, 13 (1), 80-88.

Johnson, D. W. & Johnson, R. T. (1999). Making cooperative learning work. Theory into practice, 38(2), 67-73.

Johnson, D.W., Johnson, R. & Smith, K. A. (1998). Active learning: Cooperative in the college classroom (2. edition). Edina, Mn: Interaction Book Company.

Kolawole, E. (2007). Effects of competitive and cooperative learning strategies on academic performance of Nigerian students in mathematics. Educational Research and Review, 3(1), 33-37. Retrieved September 03, 2014, from http://www.academicjournals.org/ERR

Kong, J.S.L., Kwok, R. C. W. & Fang, Y. (2012). The effects of peer intrinsic and extrinsic motivation on MMOG game-based collaborative learning. Information & Management, 49(1), 1-9.

Kus, M. Filiz, E., & Altun, S. (2014). Teacher and student thoughts on effectiveness of cooperative learning in geography teaching. Educational Research and Reviews, 9(11),312-319.

Linn, R. L. & Gronlund, N. E. (2005). Measurement and assessment in teaching (9th ed.). Upper Saddle River, NJ: Pearson/Merrill Prentice Hall.

Margolis, H. & McCabe, P. P. (2003). Self-efficacy: A key to improving the motivation of struggling learners. Preventing School Failure: Alternative Education for Children and Youth, 47(4), 162-169.

Ministry of National Education. (2005). Ilkogretim Fen ve Teknoloji dersi ogretim programı ve klavuzu [Learning teaching process: New theories and approaches]. Milli Egitim Yayinlari, Ankara.

Nichols, J. D. & Miller, R.B. (1994). Cooperative learning and student motivation. Contemporary Educational Psychology, 19 (2), 167-178.

Parveen, Q. & Batool, S. (2012). Effect of cooperative learning on achievement of students in general science at secondary level. International Education Studies, 5(2), 154-158.

Rienties, B., Tempelaar, D., Van den Bossche, P., Gijselaers, W. & Segers, M. (2009). The role of academic motivation in Computer-Supported Collaborative Learning. Computers in Human Behavior, 25(6), 1195-1206.

Saban, A. (2005). Ogrenme ogretme sureci. Yeni teori ve yaklasimlar [Learning teaching process: New theories and approaches]. (4. Baskı). Ankara: Nobel Yayın Dağıtım.

Salili, F. & Lai, M. K. (2003). Learning and motivation of Chinese students in Hong Kong: A longitudinal study of contextual influences on students' achievement orientation and performance. Psychology in the Schools, 40(1), 51-70.

Senemoglu, N. (2012). Gelisim ogrenme ve ogretim. Kuramdan uygulamaya [Development, learning, and instruction: From theory to practice]. 22. Baski. Ankara: Pegem Akademi.

Skinner, B. F. (1985). Cognitive science and behaviourism. British Journal of Psychology, 76(3), 291-301.

Slavin, R. E. (1987). Cooperative learning: Student teams. What research says to the teacher. NEA Professional Library, PO Box 509, West Haven, CT 06516.

Slavin, R. E. (1995). Co-operative learning: Theory, research, and practice. (2nd edition), Boston: Allyn and Bacon.

Slavin, R. E. & Oickle, E. (1981). Effects of cooperative learning teams on student achievement and race relations: Treatment by race interactions. Sociology of Education, 54, 174-180.

Stevens, J. (1996) *Applied multivariate statistics for the social sciences* (3rd. Ed.). New Jersey: Lawrence Erlbaum Associates.

Tarim, K. (2003). Kubasık ögrenme yonteminin matematik ögretimindeki etkinliği ve kubasık ögrenme yöntemine iliskin bir meta-analiz çalışması. [Efficiency of Cooperative Learning Method in Mathematics Instruction and a Relevant Meta-Analysis Study]. Cukurova Universitesi, Fen Bilimleri Enstitusu.

Vygotsky, L. (1978). Interaction between learning and development. In M. Gauvain & M. Cole (Eds.): Readings on the development of children, (pp. 34–41).

Yavuz, S. (2007). The effects of ınteractive learning environments on cooperative learning achievement and student anxiety in environmental education. Online Submission, 9(1), 193-204.

Yagcı, E., Kapti, S. & Beyaztas, I. D. (2012). Isbirliğine dayalı ogrenme tekniklerinin fen ve teknoloji dersinde uygulanmasına iliskin bir calisma [A Study on Cooperative Learning Techniques' Use inScience and Technology Course]. Mehmet Akif Ersoy Universitesi Egitim Fakültesi Dergisi, 12(23): 59–77.

Yoshida, H., Tani, S., Uchida, T., Masui, J. & Nakayama, A. (2014). Effects of online cooperative learning on motivation in learning korean as a foreign language. International Journal of Information and Education Technology, 4(6), 473-477.